Volume 1

# EASTERN GULF OF MEXICO MARINE HABITAT STUDY

Prepared for

U.S. Department of the Interior
Bureau of Land Management
Washington, D.C. 20240

January 1979



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Woodward-Clyde Consultants

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ABSTRACT

The primary objective of the Eastern Gulf of Mexico Marine Habitat Study was to identify and delineate marine habitat areas in 49 of the proposed lease blocks included in OCS Sale NO. 65. The lease blocks are located offshore Florida in the Gulf of Mexico. The 49 blocks were divided into 10 non-contiguous map areas for the purposes of discussion and data presentation.

High-resolution geophysical surveys and underwater television and camera ground truth surveys were conducted in support of the survey objectives. Over 1,930 km of geophysical data were collected from the following systems: depth sounders, a 3.5 kHz sub-bottom profiler, a side scan sonar, and a high-resolution seismic reflection profiler. These data, along with data previously collected for the U.S. Geological Survey and the BLM were used to produce maps of the bathymetry and sea floor sediment characteristics and a geologic cross section for each of the 10 map areas.

Upon completion of the geophysical survey, the geophysical data and preliminary interpretation maps were reviewed by scientists from Woodward-Clyde Consultants, TerEco Corporation and the BLM. Based upon this review, 23 transects in 6 map areas were selected for the ground truth survey using underwater television and a 35 mm underwater camera. Approximately 33 h of videotape and 2,500 color transparencies were collected along the 23 transects. Descriptions of bottom features and associated macro-benthic assemblages were produced for each transect.

The ground truth and geophysical data were reviewed to identify potentially critical marine habitat areas where further studies may be desired prior to initiation of any offshore operations that could affect the marine habitat. Further studies were recommended where the following conditions existed:

- A unique marine habitat was identified.
- A biological assemblage appeared to have a confined distribution.
- An insufficient data base existed.

Areas suggested for further study included:

- Reef features in Destin Dome Blocks in Areas 3 and 4
- Scattered hard bottom areas of the Tarpon Springs Map Sheet (Area 5)
- Carbonate outcrops in The Elbow, Block 567 (Area 6)
- Scattered hard bottom areas in the lease blocks of Areas 7 and 9 in the Saint Petersburg and Charlotte Harbor Map Sheets.

The existing data base required that this study be concentrated in the more unique "hard bottom" areas of the lease blocks. The majority of the areas studied have a "soft bottom". Most of the biotic activity is associated with the soft bottom which varies considerably in character and biotic productivity. The soft bottom areas represent a prime resource and must be considered in proper perspective before any judgements about the ecological and economic impacts of the lease sale can be made.

# 1.0 INTRODUCTION

## 1.1 Background

The Bureau of Land Management and the U.S. Geological Survey have been designated as the responsible government agencies for determining the effect of offshore petroleum operations on the cultural, biological and archeological resources on the continental shelf. In preparation for OCS Lease Sale No. 65, held in October, 1978, these agencies sponsored a series of studies aimed at identifying the resources on the continental shelf offshore Florida in the Gulf of Mexico. The studies concentrated on the lease blocks which had previously been identified as being of primary interest for further exploration.

The initial study "Baseline Monitoring Studies, Mississippi-Alabama-Florida Outer Continental Shelf, 1975 to 1976" was conducted by the State University System of Flordia Institute of Oceanography (SUSIO). Detailed geophysical surveys were then conducted over the lease blocks of primary interest for petroleum exploration. The purposes of the detailed geophysical surveys were to identify geological hazards and cultural, biological and archeological resources in those lease blocks. The results of those surveys have been reported in BBN (1975) and Intersea Research Corporation (1978).

The results of the previous surveys indicated that certain of the lease block areas contain features which favor the accumulation of marine biota. The distribution of these features is incompletely known. Since these features provide a suitable sub-stratum for the attachment of benthic epifauna and attract a large number of demersal fishes, the location of these critical areas within each tract would have to be accurately determined so that these areas could be protected during the exploration and development of the leases for petroleum hydrocarbons. The objectives of this study were to identify and delineate these critical marine habitat areas in 49 of the lease blocks proposed for Lease Sale 65.

## 1.2 Scope of Work

The Bureau of Land Management determined that further geophysical, bathymetric and ground truth surveys were necessary in 49 of the tracts proposed for Lease Sale 65 in order to identify areas in which the lithotope favors the accumulation of critical biota. The 49 selected tracts are grouped into 10 map areas shown in Figure 1.1 and listed in Table 1-1.

The geophysical and bathymetric survey pattern for each block was designed to supplement the data which had been previously collected by the U.S. Geological Survey for the Geological Hazards Survey. Figure 1.2 illustrates the geophysical survey pattern that was specified by the BLM for this study in each of the 49 tracts. Data from the following geophysical systems was specified to be collected along each of the survey lines.

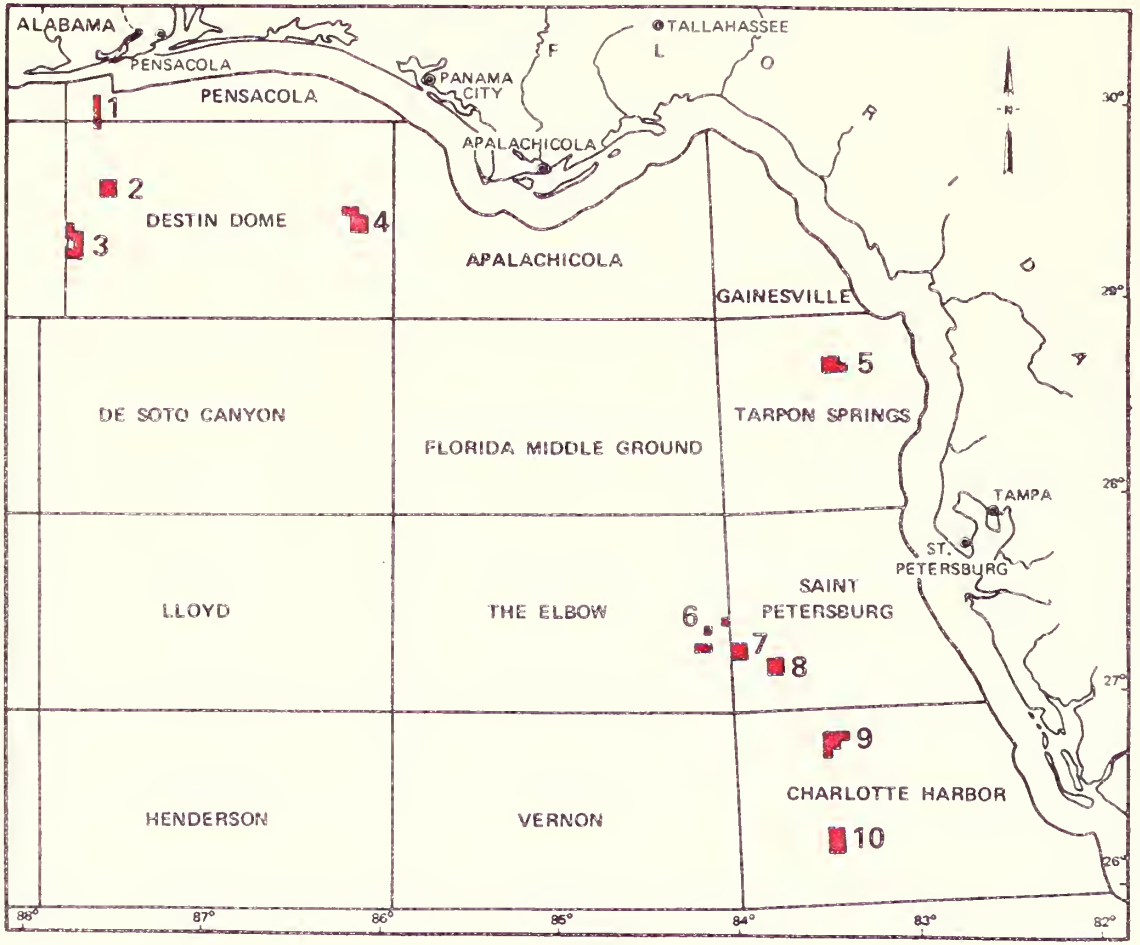
- Precision depth sounder with narrow-beam transducer
- Dual side scan sonar
- High-resolution sub-bottom profiler utilizing a tuned transducer (3.5 to 12 kHz)

TABLE 1-1

EASTERN GULF OF MEXICO
MARINE HABITAT STUDY
SURVEY AREAS

| NUMBER | AREA | BLOCK NUMBERS |
|---|---|---|
| 1 | Pensacola (NH 16-5)<br>Destin Dome (NH 16-8) | 884, 928,972<br>4 |
| 2 | Destin Dome (NH 16-8) | 313,314,357,358 |
| 3 | Destin Dome (NH 16-8) | 529, 573, 574, 618, 661, 662 |
| 4 | Destin Dome (NH 16-8) | 473, 474, 518, 519, 562, 563 |
| 5 | Tarpon Springs (NH 17-10) | 233, 234, 277, 278, 279 |
| 6 | The Elbow (NG 16-3) | 567, 609, 696, 697 |
| 7 | Saint Petersburg (NG 17-1) | 661, 662, 705, 706 |
| 8 | Saint Petersburg (NG 17-1) | 753, 754, 797, 798 |
| 9 | Charlotte Harbor (NG 17-4) | 143, 144, 145, 187, 188, 231 |
| 10 | Charlotte Harbor (NG 17-4) | 583, 584, 627, 628, 671, 672, 715, 716 |

NOTE: Blocks 715 and 716 of Area 10, Charlotte Harbor are not included in the 49 blocks to be surveyed under this contract. However, interpretation of data from these blocks is presented because they are included in Lease Sale 65 and are contiguous with the remaining blocks in Area 10.




| | | |
|---|---|---|
| Project: EASTERN GULF OF MEXICO<br>Project No. 41069 | INDEX MAP | Fig. 1.1 |

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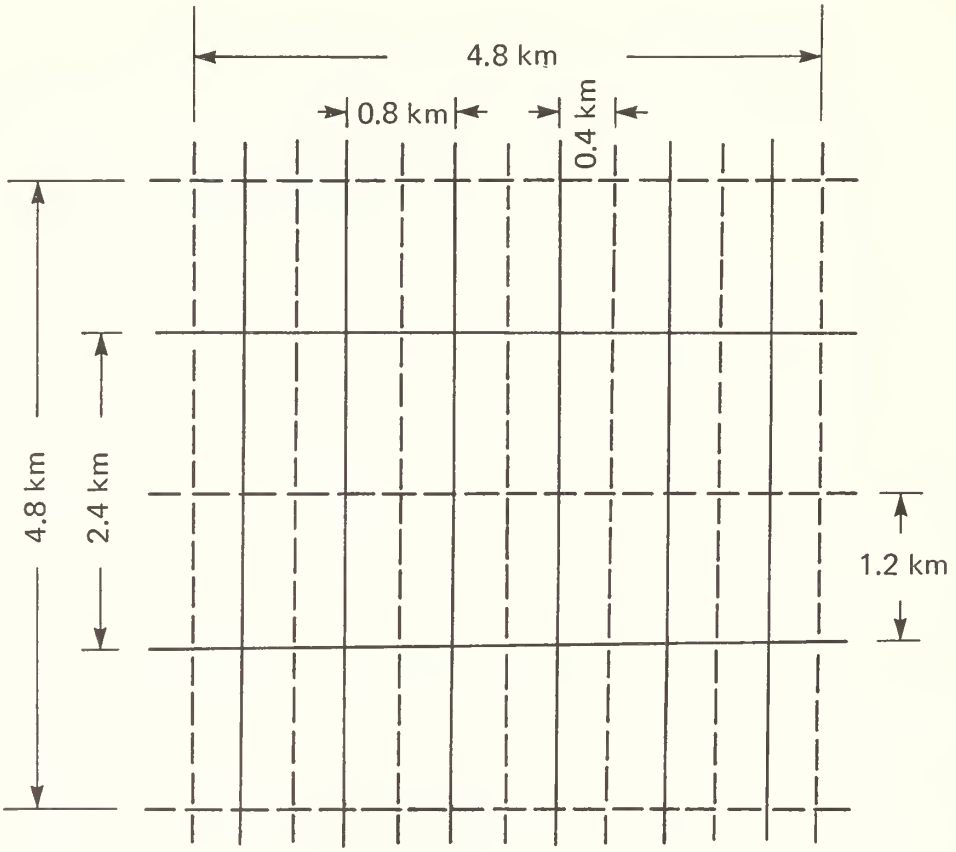


— — — U.S. GEOLOGICAL SURVEY SALE 65 HAZARD SURVEY LINES

——— SURVEY LINES FOR THIS STUDY

SCHEMATIC PLAT SHOWING REQUIRED SURVEY GRID PLAN FOR A TYPICAL BLOCK

| | | |
|---|---|---|
| Project: EASTERN GULF OF MEXICO<br>Project No. 41069 | GEOPHYSICAL SURVEY PATTERN | Fig. 1.2 |

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- High-resolution seismic sub-bottom profiler, using a mechanical or electrical-mechanical acoustic energy source.

The second phase of this study involved identification of existing marine habitats by means of a ground truth survey. The ground truth survey was conducted along transects which were selected by BLM scientists, based upon the results of the previous geophysical and bathymetric surveys. During the ground truth surveys data were collected from the following systems:

- Towed underwater closed circuit television system, with a video recorder and monitor
- Underwater 35 mm still camera system with strobe unit
- Depth sounder

## 1.3 Organization of the Report

The final report is presented in three volumes. Volume 1 is the technical report; Volume 2 contains the maps and geologic cross sections produced for each of the 10 study areas; Volume 3 is the Operation Reports. The Operation Reports contain operations and instrumentation logs and are intended for use only by those scientists who will be utilizing the original field data.

The technical report is divided into 19 sections and 2 appendicies. Section 2 describes the geophysical and biological surveys which were previously conducted in Lease Area 65. Field operations with this survey are discussed in Sections 3 and 4. Sections 5, 6 and 7 describe the basic procedures for data handling, analysis, mapping and presentation of the data from this study. Sections 8 through 17 present descriptions of the results of this survey in the 10 survey areas. Section 18 presents our recommendations for areas which may require further studies in order to accurately assess the impact of offshore petroleum operations in these areas. References to previous studies are listed in Section 19.

## 2.0 REVIEW OF PREVIOUS WORK

### 2.1 Introduction

Data from previous geophysical and biological surveys sponsored by the Department of the Interior was made available in various forms for reference and, where practical, incorporation into this study. These references are listed in Section 19 and discussed in greater detail in Section 2.2.

There is extensive literature available on the geology, oceanography and biology of the Gulf of Mexico Continental Shelf. A number of these published reports were reviewed in preparation for this study; however, they are not specifically referenced in this report. Extensive bibliographical listings on this area may be found in Bureau of Land Management (1978) and The State University System of Florida (1977).

### 2.2 Field Surveys

#### 2.2.1 U.S.G.S. Hazard Survey by Intersea Research Corporation

From November 1977 to February 1978, Intersea Research Corporation conducted a high-resolution geophysical survey in the lease blocks for Proposed OCS Sale Number 65. This survey included all blocks which are part of this study except those in The Elbow Map Sheet (Figure 1.1). The purpose of the Intersea Research Corporation survey was to provide information regarding potential hazards to future drilling development on the continental shelf down to a sub-bottom depth of approximately 600 m.

The standard equipment utilized in that survey included an echo sounder for water depth measurement, side scan sonar for continuous sea floor data, a sub-bottom profiler for near-surface sediment conditions, and a sparker system for shallow stratigraphic and structural conditions. The results of that survey were presented on the following maps at a scale of 1:48,000: Navigation Post Plot, Water Depth, Semiconsolidated Sediment Thickness, Deep Structure, and Geologic Hazards. The original geophysical records were available in the form of continuous strip microfilm copies.

Survey lines for the marine habitat survey were laid out so as to compliment the data collected in the Intersea Research Corporation Geological Hazards Survey (Figure 1.2).

#### 2.2.2 U.S.G.S. Hazards Survey by BBN-Geomarine Service Company

The four blocks in The Elbow Quadrangle had been previously surveyed by BBN-Geomarine Service Company for the purpose of determining geologic hazards in preparation for OCS Lease Sale No. 41. That survey was similar in nature to the previously described hazard survey by Intersea Research Corporation. Similar maps are available at a scale of 1:48,000, as described above; however, microfilm records of the original data from the BBN survey were not available for analysis by Woodward-Clyde Consultants.

#### 2.2.3 Baseline Monitoring Studies by the State University System of Florida

Baseline Monitoring Studies of the Outer Continental Shelf Offshore

Mississippi, Alabama and Florida were conducted by the State University System of Florida Institute of Oceanography in 1975 and 1976. These studies were sponsored by the Bureau of Land Management under Contract No. 08550-CT5-30. The results of this survey are presented in a 5-volume report, State University System of Florida (1977). The baseline monitoring studies are regional in nature; nevertheless, they provided valuable background information for the preparation of this study.

# 3.0 FIELD OPERATIONS, CRUISE I, GEOPHYSICAL SURVEY

## 3.1 Introduction

The field operations were divided into two cruises; Cruise I, Geophysical Survey; and Cruise II, Ground Truth Survey. This section provides a brief review of the field operations and a description of the equipment utilized on the geophysical survey. Further details of the field operations are given in the Project Manager's Summary, Chief Scientist's Log, Daily Operations Log, and Instrumentation Log. These reports are presented in Volume 3.

## 3.2 Operations

Field operations for the geophysical cruise began with the mobilization of the equipment aboard the survey vessel, M/V Sea Transporter, in Port Arthur, Texas, on 10 July 1978. Mobilization was completed and the boat departed Port Arthur on 13 July and arrived at the first survey area, offshore Pensacola, on 15 July. Survey operations continued on a 24-hour-per-day basis through 14 August 1978. The geophysical cruise was demobilized in St. Petersburg, Florida on 15 August.

The geophysical survey program covered 49 blocks which have been proposed for lease in OCS Lease Sale 65. The 49 blocks which were surveyed were selected by the BLM. These blocks are grouped into 10 distinct areas shown in Figure 1.1. For each block the primary survey lines were run at a spacing of 0.8 km with cross lines at 2.4 km intervals. The survey lines equally interspace the existing U.S. Geological Survey Hazard Data. In each block a total of 38.6 km of survey data were collected. The survey program for each block is illustrated in Figure 1.2. The survey vessel utilized for this study was the M/V Sea Transporter, a 40.5 m converted U.S. Navy YF. This ship is of sufficient size to provide proper working space for both the data collection and the on-board data interpretation. Further specifications of the Sea Transporter are given in Appendix A.

The geophysical operations included simultaneous data collection from the following systems along each survey line.

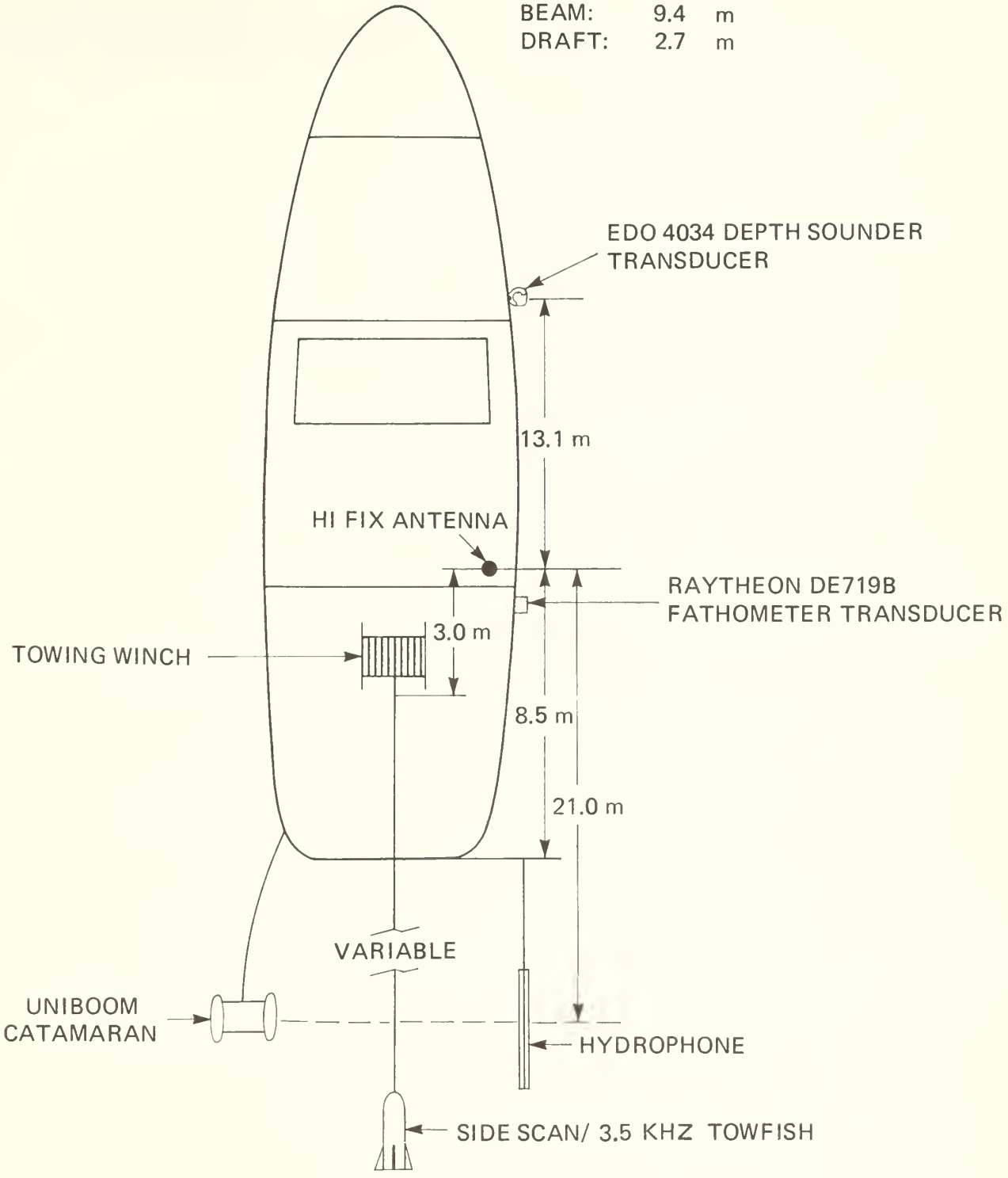
- Decca Hi-Fix Navigation System with Autocarta Plotting System
- EDO Model 4034CM Precision Survey Depth Recorder or Raytheon Model DE719B Precision Depth Recorder
- Klein Model 530 Side Scan Sonar/3.5 kHz Sub-Bottom Profiler
- E G & G UNIBOOM System

The layout of the geophysical equipment during at-sea operations is shown in Figure 3.1.

## 3.3 Equipment

### 3.3.1 Navigation System

Offshore positioning was subcontracted to Decca Survey Systems, Inc., of




| Project: EASTERN GULF OF MEXICO<br>Project No. 41069 | GEOPHYSICAL SURVEY VESSEL EQUIPMENT LAYOUT | Fig. 3.1 |
|---|---|---|

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Houston, Texas. They utilized a Decca Hi-Fix navigation system and a Decca Autocarta plotting system

The Decca Hi-Fix radio navigation system is a phase-comparison hyperbolic or range-range electronic positioning system, capable of operating out to a range of approximately 200 km, with an accuracy of about ± 3 m. The system consists of a master transmitting station, two slave transmitting stations and a ship-board receiving system. Further data on the Hi-Fix System is given in the specification sheet in Appendix A.

The Decca Autocarta system is used in conjunction with the basic navigation system. It is an on-board real-time navigational data recording and plotting system. In addition to recording all navigation data on magnetic tape and plotting a real-time ship track map, it provides navigational guidance along predetermined survey tracks in the form of a helmsman's left/right display. At the completion of the survey, the system can be used off line to provide final field post plot charts at the desired mapping scale.

### 3.3.2 Depth Sounders

Two depth sounder systems were utilized on this survey to record water depth; an EDO Western Model 4034CM depth sounder, and a Raytheon Model DE719B Fathometer. The operating principle for both instruments is the same. They emit a high-frequency signal from a transducer mounted on the side of the ship. The return signal is graphically displayed on a continuous chart. Both instruments include a draft setting to account for the depth of the transducer beneath the water surface and a calibration wheel to take into account the changes in the velocity of sound in sea water. A fix mark is placed on the depth sounder records each time a navigation fix is recorded so that the measured water depth can be correlated with the positioning data.

The EDO System was initially used on this survey because it had a greater water depth capability than the Raytheon system and because it recorded water depths directly in metres (the mapping unit for this survey). It was necessary to discontinue utilizing the EDO System approximately half-way through the survey because of a lack of metric-scale paper. The manufacturer was unable to locate any additional sources of this paper within the United States.

During the field operations the calibration of the depth sounders for changes in the velocity of sound in seawater was checked on a daily basis by means of a bar check or a lead line. Specification sheets for both depth sounders are given in Appendix A.

### 3.3.3 Side Scan Sonar and 3.5 kHz System

A Klein Model 530 Hydroscan System was utilized to provide side scan sonar and shallow penetration high-resolution sub-bottom profile data. The system consists of a Model 530 3-channel recorder and a Model 432 3-channel towfish. The towfish contains the dual side scan sonar transducers and the 3.5 kHz sub-bottom profiling transducer. The resulting records from all three transducers are presented simultaneously on the 3-channel recorder at the same horizontal and vertical scales. A fix mark is placed on the records at each navigation shot point so the data can be correlated with the navigation data. The lay

back, the distance the towfish is towed behind the navigation antenna, is recorded directly on the 3-channel record so that proper corrections can be made for the position of the towfish when interpreting the data.

The dual side scan sonar has two transducers with acoustic beams aimed slightly below the horizontal plane. Echoes from the sea floor are obtained from points directly beneath the transducers out to a distance of 25-300 m on each side of the towfish, depending upon the range setting. A range setting of 100 m was used throughout this survey. The combination of beam shape and the short wave length, 100 kHz, acoustic pulse, gives the side scan the ability to resolve small topographic irregularities and any man-made objects on the sea floor. As the transducer is towed behind the ship, the reflected echoes are graphically recorded in a form which appears like a continuous photograph of a strip of the sea floor. Specifications for the Klein System are given in Appendix A.

### 3.3.4 Sub-Bottom Profiler

An E G & G UNIBOOM High-Resolution Seismic Reflection Profiling System was used to provide shallow to moderate penetration high-resolution sub-bottom data. In several areas, due to excessive water depth, it was necessary to utilize a specially designed Woodward-Clyde Consultants Multi-Electrode Sparker Source to achieve the necessary penetration.

The E G & G UNIBOOM System consists of an E G & G Model 231 Trigger Capacitor Bank, Model 232 Power Supply, hydrophone, Model 255 Seismic Recorder and a UNIBOOM plate mounted on a catamaran. The plate is an electromechanical sound source which generates a broad band acoustic pressure pulse with a frequency spectrum from 400 Hz to 8 kHz. The multi-electrode sparker source consists of a pair of 130 electrode spark arrays. The discharge of electrical energy from the capacitor bank through the electrodes creates a gas bubble and a resulting acoustic pulse. The frequency spectrum from the spark arrays is less than that in the UNIBOOM System; the result is that the sparker provides greater penetration of the seismic signal but less resolution of the sub-bottom layers. It was necessary to use the sparker only in areas where the water depth exceeded 150 m.

The resulting seismic records from the UNIBOOM System are similar to a geologic cross section except that the vertical axis represents two-way travel time of the reflected signal rather than a true depth. Reflection times are converted to depths of the sedimentary layers using an assumed or measured value for the velocity of sound in the sediments. The system is towed behind the ship and mapping of the data requires a correction for the lay-back of the system from the positioning antenna. Specifications for the E G & G System are given in Appendix A.

# 4.0 FIELD OPERATIONS, CRUISE II, GROUND TRUTH SURVEY

## 4.1 Introduction

The Ground Truth Survey was designed to provide a permanent videotape and underwater camera record of the marine habitat in selected areas of the 49 blocks covered by the geophysical survey. Unlike the geophysical survey which covered all of the blocks, there was a fixed amount of time available for the ground truth survey; therefore, prior to sailing on Cruise II a firm schedule was prepared to determine the order of the areas to be studied and the length of time to be utilized at each area.

The preliminary results of the geophysical survey were reviewed at a meeting in St. Petersburg on August 14 and 15 by personnel from the BLM, Woodward-Clyde Consultants and TerEco, the biological consultants. Based on this review, 20 TV and underwater camera transects were laid out for the ground truth survey. Three additional transects were chosen at a later time by the Chief Scientist of Cruise II in order to further delineate side scan sonar targets in Area 3.

The locations selected for the ground truth survey are listed in Table 4-1. These areas are almost exclusively hard bottom areas or areas that were suspected of having a hard bottom. As such, they represent anomalous areas in considering the overall distribution of bottom sediment characteristics on the Florida Shelf. The hard bottom areas are of particular interest because they provide a suitable substratum for the attachment of benthic epifauna and attract large numbers of demersal fishes.

## 4.2 Operations

Cruise II began with a mobilization of the equipment aboard the M/V Sea Transporter in St. Petersburg on 15 August. The cruise terminated 28 August in Pensacola. During this cruise the following equipment was aboard the ship.

- Decca Hi-Fix Navigation System
- Raytheon Model DE719B Fathometer
- Hydro Products Underwater TV System with Video Recorder and Monitor
- Benthos Underwater 35 mm Camera

During this cruise approximately 33 h of videotape recordings from the underwater TV system and 2,500 color transparencies from the underwater camera were made. The color transparencies were developed aboard ship to insure that the camera system was working properly.

## 4.3 Equipment

### 4.3.1 Navigation System

Navigation services were provided by Decca Survey Systems, Inc., of Houston, using a Hi-Fix navigation system. This system is the same one that was used during Cruise I, Geophysical Survey, and is described in Section 3.3.1. Specifications are given in Appendix A.

Table 4-1 Locations Selected for Photographic/TV Reconnaissance

| AREA | SURVEY LINE | SHOT POINTS | FEATURE |
|---|---|---|---|
| 9 | 201 | 15-21 | Low relief and textural changes |
| 9 | 201 | 0-7 | Low relief and textural changes |
| 7 | 205 | 10-25 | Outcrops |
| 7 | 205 | 45-70 | Low relief; targets |
| 6 | 101 Block 567 | 32-35 | Low relief |
| 6 | 101 Block 567 | 4-5 | Low relief |
| 6 | 101 Block 609 | 23-25 | Low relief |
| 4 | 114 | 29-32 | Pinnacles |
| 4 | 114 | 20-23 | Pinnacles |
| 4 | 108 | 85 | Minor relief |
| 4 | 108 | 64-75 | Medium relief |
| 4 | 104 | 75-90 | Linear features |
| 3 | 205 | 32-34 | Textural changes |
| 3 | 108 | 30-33 | Medium relief |
| 3 | 108 | 37-39 | Low relief |
| 3 | 103 | 66 | Major relief |
| 3 | 106 | 33, 41, 34 | Medium relief |
| 3 | 112 | 4-5 | Major relief |
| 3 | 112 | 97-100 | Pinnacles |
| 2 | 101 | 52 | Textural changes |
| 2 | 101 | 31 | Minor relief |
| 2 | 101 | 67 | Textural changes |
| 2 | 102 | 10 | Textural changes |

### 4.3.2 Depth Sounder

A Raytheon DE719B Fathometer was aboard during Cruise II. Since the bathymetric data had been collected on the previous survey, the depth sounder was used primarily to aid in the control of the underwater television sled. The depth sounder is described in Section 3.3.2. Specifications are given in Appendix A.

### 4.3.3 Underwater Television System

The underwater television system consisted of a Hydro Products Model TC125 Camera, Model SC303 Control System and Monitor, Model RP3 Pan and Tilt Mechanism and Model L7 Light. The entire television system was mounted in a sled which was generally towed along behind the ship. A towing speed of less than two knots was required in order that the videotape records could be clearly observable. A Sony Model AV3650 Video Recorder was used for this purpose. Specification sheets for the TV system are presented in Appendix A.

### 4.3.4 Underwater Camera

The underwater camera system consisted of a Benthos Model 372 Deep Sea Standard Camera and a Model 382 Flash Unit. The camera and flash unit were mounted on the arm of the pan and tilt mechanism for the underwater television so that the camera would always be in a position to take a photograph of the objects which were being observed on the TV monitor. Specifications for the camera system are given in Appendix A.

## 5.0 FIELD DATA: MANAGEMENT AND DISTRIBUTION

### 5.1 Introduction

Geophysical data and ground truth data were collected for this survey. The data have been analyzed for the purpose of locating and delineating hard bottom areas that support biological communities. The results of the analysis are summarized on a series of maps presented in Volume 2 of this report. It is expected that portions of the data will be examined in greater detail and reinterpreted in the light of additional knowledge. If properly documented and stored, data from this survey can be used for continuing analysis and advancement of knowledge of the shallow geology and biology of the Gulf of Mexico Continental Shelf area.

The purpose of this short section of the report is to identify the available field data records and the ultimate distribution of this data so that it may be utilized in the future.

### 5.2 Management and Control Procedures

A data management plan was implemented throughout this study to insure that the data met survey specifications and the location of the data was accurately known at all times. The basic elements of this plan are:

- Review of the field data onboard ship by the Chief Scientist and the BLM Representative to insure the data quality met survey specifications before the ship left each survey area.
- Use of transmittal forms to document the transfer of all data.
- Obtaining duplicate copies or microfilm records of all original field data.

### 5.3 Field Data Records

The following data records were obtained in the field or as a result of processing the navigation data.

1. Navigation post plots at a scale of 1:48,000.
2. Computer listing of grid coordinates for each shot point from both the geophysical survey cruise and the ground truth survey cruise.
3. Analog records from the following geophysical systems:
   - Depth Sounder
   - E G & G UNIBOOM
   - Klein Deeptow Side Scan Sonar/3.5 kHz Sub-Bottom Profiler
4. 33 videotapes from the 23 TV transects.
5. Approximately 2,500 35 mm color transparancies.

6. All daily operations logs and instrument logs. These logs are included in Volume 3 of this report and are necessary for the proper analysis and interpretation of the field data.

## 5.4 Distribution of the Data

Upon completion of the final report all original field records and logs were sent to the Bureau of Land Management, New Orleans OCS Office, Hale Boggs Federal Building, 500 Camp Street, New Orleans, Louisiana. Copies of the data are not being retained by Woodward-Clyde Consultants and all requests for the data should be directed to the Bureau of Land Management.

One microfilm copy of all the geophysical records was sent to the National Geophysical and Solar Terrestrial Data Center, EDS/NOAA in Boulder, Colorado.

## 6.0 MAPPING AND INTERPRETATIONAL PROCEDURES

### 6.1 Introduction

Section 6 briefly discusses the procedures used in making the visuals which are presented as part of this report and in interpreting the geophysical and ground truth data.

### 6.2 Base Map Preparation

Base maps for the 10 map areas were prepared as direct copies from portions of large area base maps furnished by the Bureau of Land Management. The maps are at a scale of 1:48,000 and show latitude and longitude, UTM grid coordinates in feet, and the lease block boundaries. The maps are based on a UTM projection using the Clarke 1866 Spheroid.

### 6.3 Navigation Post Plot Maps

Navigation post plots at a scale of 1:24,000 were produced onboard the ship in real time by the Autocarta system. These maps were utilized as the base maps for preliminary mapping of the data. Upon completion of the survey, the navigation data which had been recorded on magnetic tape during the survey was plotted at a scale of 1:48,000 by Decca Survey Systems. These plots were transferred to the base maps to produce the navigation post plot maps submitted with this report. The navigation post plot maps show the ship survey track lines and each navigation fix point.

### 6.4 Bathymetry Maps

Raw bathymetric data from depth sounder records may require corrections for several factors in order to convert these data into true water depths. These factors include the depth of the transducer beneath the water, changes in the velocity of sound in the water, and tidal corrections. In areas of steep bottom slopes, a slope correction may be necessary.

During this survey the depth of the transducer beneath the water surface was corrected automatically by a draft setting on the depth sounder.

Throughout the survey, checks were made on the speed of sound in water in order to accurately maintain the depth sounder calibration. These checks included bar checks and, in shallow water areas, lead line checks. Whenever necessary the depth sounders were re-calibrated to account for any minor changes. This calibration procedure proved satisfactory except in Areas 2, 3 and 4 where rough seas and deep water prevented accurate measurement of the velocity of sound and its possible variation with depth. In these areas the fathometer calibration adjustment was left at a constant setting. An accurate calibration check was made at the completion of surveying in Area 4 and it was determined that the setting was approximately 8% low. A correction factor of 1.08 was applied to the data from these areas.

Tide ranges within the Gulf of Mexico Survey Area during the time of this survey were generally much less than the 1 m contour interval chosen for the presentation of the data. Therefore, tide corrections were not necessary in order for the data to tie together at the ship track line crossings.

The corrected bathymetric data were plotted at each shot point on preliminary base maps at a scale of 1:12,000. Intermediate points were plotted in areas where the bathymetric relief exceeded 1 m between shot points. These data were then contoured. Bathymetric records from the U.S. Geological Survey Hazards Survey were reviewed to confirm and delineate individual sea floor features. Anomalies of <2 m relief which appeared on a single line were not contoured unless their horizontal extent could be confirmed on the side scan records or from the Hazards Survey data. There were many features, with vertical relief in the range of 0-2 m and limited aerial extent, which could not be mapped at a scale of 1:48,000.

The maps prepared from data collected for the Marine Habitat Survey were compared with existing NOAA charts and the bathymetry maps prepared for the U.S. Geological Survey by Intersea Research Corporation (1978) and BBN (1975). In general, there is close agreement in both contour form and absolute water depth between the Marine Habitat Survey Bathymetry Maps and the NOAA Charts. The NOAA Charts are contoured at a 2 m interval and are presented at a scale of 1:250,000. The NOAA charts were used primarily for determining contour trends which required data from outside the survey area for proper development.

The U.S.G.S. Hazard Survey Bathymetry Maps are presented at a scale of 1:48,000, and contoured at either a 10 ft (3.05 m), 5 ft (1.52 m) or 2 ft (0.61 m) interval. Detailed comparisons of these maps with the Marine Habitat Survey Bathymetry Maps reveal apparent horizontal and vertical surveying discrepancies. Most of the apparent vertical differences can be attributed to velocity corrections, contour interval or instrumentation errors in positioning or water depth measurement. Woodwad-Clyde's values are generally 1-2 m deeper than Intersea's in water depths of <100 m and 3-5 m deeper in the deep water areas. A 3-4% velocity correction will reconcile most vertical discrepancies. The contour shapes and trends, which often appear different on the two sets of maps, result from different contouring techniques and varying contour intervals. In relatively flat areas it is possible to have a latitude of 0.5-1 km in the placement of an individual contour line. Local topographic features such as pinnacles, reefs, dunes or troughs which were not mapped in the hazard survey because of line location or choice of contour interval can also lead to apparent discrepancies.

### 6.5 Sea Floor Sediment Characteristics

A map of the sea floor sediment characteristics was prepared for each of the 10 areas as an aid to delineating critical marine habitat areas. The sea floor sediment characteristics maps are based on an interpretation of the side scan sonar records, sub-bottom profile records and a comparison of the characteristic reflections from these geophysical records with the videotapes and underwater photographs from the ground truth survey.

For the purpose of mapping, the sea floor sediment characteristics are divided into six categories.

> Pinnacles: Coral reefs or bedrock outcrops that extend 2 or more metres above the sea floor are mapped as pinnacles. The horizontal extent of the pinnacles may range from 100 m to less than 5 m. The pinnacles may be covered with a very thin veneer (a few centimetres) of fine sediments

or may extend as hard outcrops. Pinnacles were mapped only in Areas 3 and 4 on the flanks of De Soto Canyon.

Hard Bottom: Hard bottom has been defined as extensive areas of exposed limestone or reefs of low relief (<2 m). The horizontal extent of individual outcrops is generally on the order of a few metres, precluding their mapping as individual features. Between the outcrops and hard bottom areas are patches containing a thin veneer of sand; the top of the outcrops may also be covered with a thin veneer of sediment.

Scattered Hard Bottom: Scattered hard bottom has been defined as areas of local outcrops, reefs or exposed limestone bedrock interpsersed with extensive areas of thin sediment cover as much as 3 m thick. The distinction between areas which have been mapped as hard bottom and scattered hard bottom is, of necessity, qualitative and is based primarily on the relative density of the exposed outcrops.

Coarse Bottom: Coarse bottom has been defined as areas where the side scan sonar records show a coarse-textured sea floor. The coarse texture appears to result from either bedrock or reef rubble sitting on a thin sediment cover, or from biological activity that has created local irregularities within a coarse sandy bottom area.

Bedforms: Bedforms are areas of sandy bottom that show current or ripple marks or other low relief swells or dune-type features. These areas are essentially soft bottoms and they contain very few outcrops or reef structures within the mapped bedform area.

Soft Bottom: Soft bottoms are areas of sand, silt or mud bottom devoid of a significant number of side scan sonar targets.

Color transparencies and geophysical records which illustrate the 6 interpreted sea bottom categories are presented in Appendix B.

The sea floor sediment characteristics are presented as an overlay to the bathymetric maps with each of the 6 categories represented by a distinguishing pattern. It is emphasized that even though there was local ground truthing to support the interpretation of the geophysical records, the maps of the sea floor sediment characteristics are largely qualitative and different interpreters may choose to present these data differently. In general, the boundaries between areas are gradational and not sharply delineated as would be interpreted from the patterns on the maps.

## 6.6 Geologic Cross Sections

For each of the 10 map areas a geologic cross section is presented at a scale of 1:24,000. The cross sections are oriented approximately down-dip based upon the deep structure as shown in the Geological Hazard Survey data for the area. The geological cross sections are essentially line drawings from a single UNIBOOM record across the survey area. They are intended to show only the shallow sedimentary horizons and structures and in general are limited to a thickness of 75 m or less, depending upon the penetration of the UNIBOOM signal.

Since no bottom samples or cores were collected in conjunction with this survey, the interpretation of the nature of the individual sedimentary horizons is qualitative and based upon the reflective characteristics of the beds themselves. In the cross sections we have chosen to identify the following characteristics:

- The sediment characteristics on or near the sea floor.
- Major reflecting horizons.
- Acoustical bedrock, defined as a horizon beneath which there is little or no penetration of the UNIBOOM signal.

In addition, the cross sections show individual features such as bioherms, outcrops, and shallow buried channels.

## 6.7 Identification of Biological Assemblages

The ground truth surveys are concentrated in hard bottom areas and cover less than one percent of the surface area of the 49 lease blocks in this study. The ground truth data is valuable in confirming the side scan sonar and sub-bottom profile record interpretations and aids in the utilization of the geophysical data for the identification, classification and mapping of the bottom sediment characteristics.

The videotapes and color transparencies from the ground truth survey also provide information concerning the denisty of the biological activity and the association between biological assemblages and marine habitats. The geophysical data cannot be used to extend this information. Therefore, the limited extent of the ground truth surveys precludes any generalizations regarding relationships between bottom sediment type and biological assemblages or density of biological activity. For this reason, the identification of biological assemblages and their relative densities are discussed only in relationship to the individual transects which were run in a specific survey area.

Our recommendations for areas that require further study are presented in Section 18. These recommendations are based upon the relative abundance of hard bottom sites within a given lease block area and the observed biological associations with the hard bottom areas. It has been suggested in Bureau of Land Management (1978) that such further studies be included in stipulations for the lease block areas in order to obtain permits for sea floor operations.

## 7.0 PRESENTATION OF RESULTS

### 7.1 Introduction

The geophysical and ground truth records were analyzed for the purpose of locating and delineating hard bottom areas that support the growth of biological communities. For the purpose of presentation of the results, the 49 surveyed blocks are grouped into 10 map areas. Each map area is discussed in detail in Sections 8 through 17. A summary of the results from all areas is presented in Section 18.

### 7.2 Maps and Cross Sections

For each of the 10 map areas the following visuals were produced:

- Navigation Post Plot Map
- Bathymetry and Sea Floor Sediment Characteristics Map.
- Geologic Cross Section

The navigational maps show the ship track lines and each shot point from the geophysical survey. The location of the ground truth survey transects is also shown on these maps.

The bathymetry is contoured at a 1 m interval and the sea floor sediment characteristics are shown as various patterns overlaying the bathymetry. All maps are produced at a scale of 1:48,000.

A geological cross section extending approximately down-dip is presented at a scale of 1:24,000 for each map area. The cross sections are constructed from analysis of the UNIBOOM records and are intended to show only the shallow sedimentary structures.

The maps and cross sections are in Volume 2 of this report.

### 7.3 Discussions

The 10 map areas are discussed in detail in Sections 8 through 17. The discussions are based upon a review of the geophysical field records, the videotapes and the underwater photographs. The original records however, provide greater detail about the nature of the sea floor, sub-bottom sediments, and the biological habitats than can be shown on the maps at a scale of 1:48,000 or presented in the discussions.

## 8.0 AREA 1: PENSACOLA BLOCKS 884, 928 and 972 DESTIN DOME BLOCK 4

### 8.1 Location

Area 1 is located approximately 53 km southwest of Pensacola, Flordia. It is within the area bounded by latitudes 29°56'N and 30°07'N and longitudes 87°35'W and 87°38'W.

### 8.2 Bathymetry

The bathymetry is illustrated on Map Sheet 1 of 10. The water depths in Area 1 range from 18 m in the north to 32 m in the south. The sea floor has a variable slope in a generally southerly direction. Block 884, in the north, contains irregular east-west trending highs and lows with 2-3 m of relief. The remaining blocks have broad and indistinct minor irregularities generally <2 m in height. At the southern boundary of the area there is an east-west trending low with approximately 4 m of relief.

### 8.3 Sea Floor Characterization

No bottom photographs are available from Area 1. The description of the sea floor is based upon interpretation of the geophysical records and on similarities with the side scan sonar records from Area 2 where bottom photographs are available. The entire sea floor in Area 1 appears to be a soft bottom area covered with a layer of unconsolidated sediments consisting of fine silts and poorly sorted sands with shell fragments. The side scan sonar records indicate a very monotonous soft bottom sea floor.

Blocks 884 in the north and 4 in the south are largely covered by a soft bottom with numerous depressions and mounds. The smaller depressions and mounds are 5-10 cm in dimension and are the most numerous. A few larger features of 1-2 m in dimension are also seen in these areas. In the central portion of the area, Blocks 928 and 972, the water bottom is quite flat and the sea floor is covered with ripple marks. Most of the ripple marks have a wavelength of 1 m or less and are laterally continuous for several metres. The orientation of the ripples is consistently east to west. These ripple marks are generally only visible when towing the side scan in an east-west direction, parallel to their orientation.

### 8.4 Sub-Bottom Geology

A geologic cross section based upon north-south trending UNIBOOM line 104 is presented on Sheet 1 of the Geologic Cross Sections. The area is covered by a 5-7 m thick section of unconsolidated sediments overlying a continuous reflecting horizon that dips very gently to the south. Occasional reflectors indicating buried channels or features associated with sediment build-up are seen within this section. Beneath the marker horizon described above are a series of discontinuous reflectors within what is interpreted to be a section of semiconsolidated to consolidated sediments. These reflectors indicate the structure dips gently to the south. The upper portion of the semiconsolidated sediments shows numerous buried channels and appears to have been eroded at a period when sea level was lower.

## 8.5 Biological Associations

No ground truthing was done in Area 1 and the following conclusions are based upon television and camera observations of similar bottom characteristics in Area 2. The small mounds and depressions most likely represent bioturbation. Benthic fish and echinoderms are expeted to be fairly common in this area. The ripple covered areas also probably contain fish and echinoderms but appear to be devoid of any signs of bioturbation which can be detected on the side scan sonar.

## 9.0 AREA 2: DESTIN DOME BLOCKS 313, 314, 357, 358

### 9.1 Location

Area 2 is located approximately 88 km southwest of Pensacola, Florida. It is bounded by latitudes 29°35'N and 29°41'N and longitudes 87°28'W and 87°35'W.

### 9.2 Bathymetry

The water depths in Area 2 range from 39 m in the northwest portion of the area to 72 m in the southeast. The water bottom slopes smoothly toward the southeast at approximately 1.2 $m \cdot km^{-1}$. The southeast sloping sea floor is interrupted by a broad nose extending south across Block 313 in the northwestern portion of the area.

### 9.3 Sea Floor Characterization

The sea floor characteristics have been interpreted from the geophysical records and from 4 ground truth transects. The TV transects were selected for the purpose of observing the changes in bottom sediment texture seen on the side scan sonar records. The sea floor sediments are grouped into 4 categories which are shown as an overlay on the bathymetry map.

Scattered hard bottom occurs in the northeast quarter of Block 357 and in the southeast portion of Block 358. These areas contain scattered bedrock outcrops and are usually covered with a very thin veneer of sediments. The outcrops are generally <1 m high and 1-3 m long.

Coarse bottom areas are mapped along the 55 m water depth contour in Block 357 and in the northeast corner of Block 314. These areas show numerous small side scan sonar targets which may reflect carbonate or reef rubble resting on the surface. The sub-bottom profiler shows little or no penetration in these areas.

Ripple and dune-like features are mapped over a large portion of Block 314 and occur locally in Blocks 357 and 358. The dune-like features have wavelengths of up to 20 m with amplitudes generally <1 m. The ripples are generally 1 m in wavelength and 2-3 m long. Their orientation is variable.

The majority of Area 2 consists of a featureless soft bottom. The sediment textures range from a fine mud to a coarse poorly sorted sand containing shell fragments. The soft bottom areas contain numerous small mounds and depressions generally on the order of 5 cm across with 1-3 cm relief.

### 9.4 Sub-Bottom Geology

A geologic cross section from UNIBOOM line 105, which runs north-south through the western part of Blocks 314 and 358, is presented on Sheet 1 of the Geologic Cross Sections.

The sea floor is underlain by a section of unconsolidated to semiconsolidated sediments, 5-12 m thick. Except in the northern portion of the area, this section of sediments appears to be devoid of internal structures. This section of sediments overlies a prominent reflecting horizon which is

continuous throughout the area. This reflector shows a gently undulating surface that may be a buried erosional surface. Another prominent reflecting horizon, that may represent the top of the consolidated sediments, dips gently to the south across the area at a depth of 120 to 140 m. This latter horizon generally parallels the sea floor and is approximately 40 m beneath it.

## 9.5 Biological Associations

The soft bottom area shows signs of bioturbation ranging from tracks, small holes and depressions of a few centimetres to larger mounds and depressions as large as 1 m in diameter. The soft bottom is devoid of attached fauna. Echinoderms (starfish and sand dollars) are regularly distributed on the bottom. Benthic fishes are common in this area. Sea robins and flounders were observed in and around the larger depressions. All of the areas mapped as coarse or scattered hard bottom were not directly observed; however, based on observations in other areas, they probably have some minor numbers of attached organisms such as sponges and sea whips. The scattered hard bottom areas have a potential for a large number of attached organisms; however, a thin veneer of fine sediments was observed over much of these areas and may be limiting the attached marine life.

A summary of the biological observations of the 4 TV transects is given below. The location of the transects is shown on the Navigation Post Plot Map.

- Transect A-A': Block 358:
  West to east across line 101 at shot point 67.

  The bottom is soft and composed of fine sand or silt mixed with shell fragments. Very few attached organisms were seen on the flat bottom. Evidence of bioturbation includes tracks, small holes and shallow depressions (5 cm across, 1-3 cm deep). Organisms encountered included: sand dollars (probably genus Clypeaster); a starfish; a pair of porcupine fish (?Chilomycterus antillarum); several types of sea robins (family Triglidae); and flounders (probably family Bothidae). One major outcrop with a branching alcyonarian at the base was observed. The outcrop has a thin sediment cover and is <1 m high. It contains reddish and white growths (probably sponges) and other attachments which might be hydroids.

- Transect B-B': Block 358:
  West to east across line 101 at shot point 52.

  The bottom is soft and varies from fine silt to coarse sand with shell fragments. A few shallow depressions (5-10 cm across, 5 cm deep) were observed. Organisms associated with the bottom included: echinoderms (starfish and sand dollars); occasional benthic fish; some anemones; and two squid. One major outcrop was seen approximately 4 m high and with little attached fauna. The outcrop is covered with a layer of sediment and appears clay-like (i.e., siltstone). Cardinal fish (family Apogonidae) were observed.

- Transect C-C': Block 314:
  West to east across line 102 at shot point 10.

  The sediment varies from very fine silt to coarse sand with fragments of

shells. The water over the fine sediment bottom appears turbid. No relief or outcrops were encountered. Bioturbation occurs in the form of small diameter holes and shallow depressions. Three types of starfish were seen including Narcissia sp. and perhaps genus Astropecten. One curly antipatharian sea whip was seen. Several kinds of benthic fishes, including triglid sea robins and synodontid lizard fishes, and a portunid swimming crab were observed.

Transect D-D': Block 314:
South to north along line 102 at shot point 10.

The sediment is fine silt to coarse mixed sand and shell material. Bioturbation appears as shallow depressions and small diameter holes in the softer sediment areas. Organisms that were seen included a sponge, a starfish, a possible scallop, a squid and several types of benthic fishes. Sea robins (family Triglidae), lizard fish (family Synodontidae), a porgy (family Sparidae), a bass (family Serranidae) and a skate (Raja sp.) were all observed.

## 10.0 AREA 3: DESTIN DOME BLOCKS 529, 573, 574, 618, 661,662

### 10.1 Location

Area 3 is located approximately 137 km southwest of Pensacola, Florida. It is approximately bounded by latitudes 29°15'N and 29°28'N and longitudes 87°40'W and 87°47'W.

### 10.2 Bathymetry

The water depths in Area 3 range from 68 m in the northwest portion of Block 529 to 375 m in the southeast corner of Block 662. In the northern portion of the area, Block 529, the water bottom slopes toward the south-southeast smoothly at approximately 0.4 $m \cdot km^{-1}$, except in the southeast corner of Block 529 where there is an escarpment. Broad pinnacles, 2-3 m high and locally higher (6-9 m), occur at the top of the escarpment. This escarpment is at a water depth of approximately 75 m and trends southwestward into the northern portion of Block 573. South of this escarpment, the water bottom slopes approximately 1.6 $m \cdot km^{-1}$. The slope increases to 6-8 $m \cdot km^{-1}$ at the 94 m depth where a few 1-2 m high irregularities are found. At depths of 120 m the slope suddenly increases to 60-80 $m \cdot km^{-1}$. Pinnacles with local relief of as much as 12 m are found in the northwest corner of Block 661 at water depths of approximately 110 m. Southeast of the 120 m contour the water depth increases steeply and smoothly to over 350 m.

### 10.3 Sea Floor Characterization

The majority of Area 3 consists of a featureless soft bottom with numerous small mounds and depressions similar to those described in Areas 1 and 2. A unique feature of Area 3 is a band of mounds and depressions in the depth range of 180-280 m. In this area the depressions and mounds may have widths of over 10 m. The bottom sediment in the soft bottom area appears to consist of fine silts, grading into coarser sands mixed with shell fragments.

A small area of dune-like features occurs in the central portion of Block 618 at a water depth of approximately 130 m. These features have a relief of <1 m.

Areas of scattered hard bottom have been mapped on the fringes of the larger extensive hard bottom areas. The scattered hard bottom in these areas consists of scattered reef outcrops largely covered by sediments.

Extensive hard bottom areas consisting of pinnacles and very irregular reef-like features are found along two northeast trends. The northern trend occurs at a water depth of approximately 72-80 m and extends across the northern portion of Block 573 and the southern portion of Block 529. The second trend occurs at a water depth of approximately 115 m and extends across the northwest portion of Block 661 and possibly into the west-central part of Block 618.

### 10.4 Sub-Bottom Geology

A north-south geologic cross section based on UNIBOOM line 106 through Blocks 574, 618 and 662 is shown on Sheet 1 of the Geologic Cross Sections.

The sea floor contains a blanket of unconsolidated to semiconsolidated sediments 5-15 m thick which show few internal reflections. At the north end of the line and at the slope break reef structures protrude through these sediments to form pinnacles and extensive hard bottom areas. The thickness of the unconsolidated sediments appears to increase in water depths in excess of 120 m.

Beneath the sea floor sediments the sub-bottom profile records show a series of complexly folded and dipping reflectors. North-south lines show reflectors which generally dip to the south but contain numerous angular unconformities at several depths. East-west lines show even more complex structures and angular unconformities. These features appear to be indicitive of older surfaces with slopes similar to those of the present bottom. Some faults and folds were also identified in the deeper reflectors.

## 10.5 Biological Associations

The soft bottom areas have numerous small holes and shallow (5-12 cm) depressions and mounds. The small holes may be associated with ophichthid eel and polychaete activity. A few starfish are present and fish were observed on the bottom in the vicinity of depressions.

Pinnacles and other scattered hard bottom features are generally surrounded by and covered with a thin veneer of fine sediment. This sediment veneer appears to preclude the development of extensive or diverse forms of attached marine organisms. Soft corals such as paramuricid sea fans and antipatherian sea whips are scattered over the outcrops. Sponges, branching corals and basket stars occur over the outcrops at a density of 1-3 $m^{-2}$. Reeffish are also present in these areas. The surrounding flat-bottom areas contain sea urchins, crinoids, and benthic fish.

Six television transects were run in Area 3. The results of the observations on these transects are summarized below. The transects are plotted on the Navigation Post Plot Maps.

- Transect A-A': Block 618:
  West to east 90 m north of line 205 at shot point 33.

  The sea bottom consists of very fine sediment. It is soft and more or less flat, with widely scattered depressions. These depressions are shallow, only 5-10 cm across and are sometimes in groups. They may be associated with ophichthid eels. A few benthic fish were seen on the videotape recording.

- Transect B-B': Block 618:
  Northeast to southwest crossing line 205 at shot point 34.

  The bottom surface is monotonous except for scattered shallow depressions and groups of mounds with 10-20 cm vertical relief. Fishes, including bar-eyed tilefishes (Caulolatilus intermedius) and priacanthid bigeyes were seen hovering over large depressions and holes. One hermit crab and one starfish were seen.

- Transect C-C': Block 618:
West to east across line 103 north of shot point 66.

The bottom consists of very fine sediment with scattered 10 cm high mounds and burrows, and depressions ranging in diameter from 2-10 cm. A few fish were observed in or around holes. Attached organisms were uncommon, although a probable yellow sponge and an occasional sea whip were seen. Small holes in the sediment may be associated with ophichthid eel and polychaete activity.

- Transect D-D': Blocks 529 and 573:
West to east across line 108 south of shot point 37.

Organisms which were seen on the flat bottom included sea urchins, benthic fish and crinoids. Impressions in bottom suggest the presence of starfish. The fauna are widely scattered. Major outcrops rise 5-8 m from the sea floor. The outcrops are composed of carbonate rock with ledges and overhangs. A fine sediment cover is found on the top surface of the outcrops. An increased biological community diversity seen on the outcrops included: black and white encrusting organisms (sponges); small branching corals (Oculina-like); soft, branching coral (alcyonarian); sea whips (Cirripathes); basket stars (Echinodermata). The presence of sediment veneers on the tops of the outcrops probably precludes the formation of diverse faunal assemblages in this area.

- Transect E-E': Block 573:
West to east across line 106 south of shot point 35.

Major outcrops of hard carbonate occur along this transect. Flat areas of coarse sand and shell fragment were very limited. The outcrops have a veneer of fine sediment and soft corals, in the forms of antipatharian sea whips and branching corals, and paramuricid and muricid sea fans are scattered over the outcrops. Hard coral-like growths (probably Oculina sp.) are found on the pinnacles. One shrimp and scattered basket stars were observed. Fish were not seen.

- Transect F-F': Block 661:
Southeast to northwest across line 112 at shot point 98.

Major outcrops rise 6-12 m above a flat bottom. Only the tops of the outcrops could be observed and these are generally covered with a fine sediment. Soft alcyonarian corals (paramuricid sea fans and antipatharian Cirripathes-like sea whips) are common. Occasional patches of what appeared to be hard branching coral (probably genus Oculina) were seen attached to some projections of hard substratum. Basket stars (Echinodermata) commonly appear associated with the alcyonarian corals. Signs of black encrusting organisms (sponges) and attached white organisms (solitary corals) were noted. Fishes were uncommon, possibly due to the presence of the camera system. "Reeffish A" was recorded (see Area 4) and amberjacks (Seriola sp.) were common in the waters above the pinnacles.

## 11.0 AREA 4: DESTIN DOME BLOCKS 473, 474, 518, 519, 562, 563

### 11.1 Location

Area 4 is approximately 80 km southwest of Panama City, Florida. It is bounded by latitudes 29°25'N to 29°33'N and longitudes 86°02'W to 86°11'W.

### 11.2 Bathymetry

The water depth ranges from 72 m on the northeast side of Block 519 increasing to 115 m at the southwest side of Block 562. The sea floor slopes gently to the southwest with only a few irregularities. All of the irregularities occur between the 86 and 90 m contours and consist mainly of tall pinnacles and outcrops rising 2-3 m above the sea floor. Individual pinnacles are sometimes taller; one encountered on the southeast corner of Block 473 rises 11 m above the surrounding sea floor.

### 11.3 Sea Floor Characterization

The sea floor sediments of Area 4 consist predominantly of unconsolidated silty carbonate sands and shell fragments. The sands are poorly sorted and are affected very little by benthic currents. Generally, the sandy bottom is featureless except for small (10-30 cm-diameter) mounds and craters and tracks formed by benthic organisms. The 3.5 kHz sub-bottom profiler indicates that most of the area is blanketed by 1-2 m of semiconsolidated or unconsolidated sediments. These sediments generally thicken to as much as 4 or 5 m at the eastern edge of Blocks 519 and 563, and they become patchy and pinch out in the western part of Blocks 473, 518 and 562.

In the southeast quadrant of Block 473 and the southcentral and central portions of Blocks 518 and 562, biogenic carbonate crops out and forms bathymetric highs and pinnacles that may rise as much as 11 m above the sea floor. Adjacent to the biolithic outcrops, carbonate fragments from the outcrops often litter the sea floor.

### 11.4 Sub-Bottom Geology

A geologic cross section along line 205 across blocks 562 and 563 is shown on Sheet 2 of the Geologic Cross Sections.

The UNIBOOM sub-bottom profiler indicates that all of Area 4 is underlain by nearly horizontal sediments that are slightly inclined to the southwest parallel to the sea floor. The upper 75-110 m of sediment are almost transparent to the profiler in the eastern half of the area with few distinct marker horizons. Strong reflectors are more abundant in the western half of the area. At depths below the mudline ranging from 30-60 ms, a strong irregular reflector suggests an erosional disconformity throughout all the blocks. Below the disconformity to depths of 100 ms below mudline, large well-developed cross-bedding indicates an older deltaic environment in Blocks 519 and 563. The cross-bedding gradationally changes to flat-lying sediments west of Blocks 519 and 563.

Buried bioherms ranging in depth of burial from 5 to 30 ms are evident in the western parts of Blocks 473, 518 and 562. The location of these buried

features roughly corresponds to the distribution of outcrops described in the previous paragraph. It is probable that both the bioherms and carbonate outcrops originated from coral colonies that died subsequent to deep submergence due to changing sea levels during regional subsidence.

The deep sub-bottom structure of Area 4 gently dips southwest similar to the sea floor. A small structural high extends between the southwest quadrant of Block 519 and the northwest quadrant of Block 563.

## 11.5 Biological Associations

The sea floor is composed mostly of soft, fine, sandy sediment. Fishes were observed living on the sediment and in holes or burrows. These included synodontid lizard fishes, what appeared to be ophichthid eels, porgies (probably the spottail pinfish Diplodus holbrooki), a bothid flounder, several species of triglid sea robins and a goatfish (probably Mullus auratus). Sand dollars (probably Clypeaster ravenelii), several types of starfish, echinoids (Diadema and Stylocidaris) and hermit crabs were seen widely scattered during transects in Area 4. Small mounds, depressions and a variety of tracks suggest these organisms are either quite mobile or in numbers greater than those suggested by the video records.

Areas of coarser sediment in Block 563 were found to support additional types of organisms including sponges, a variety of soft corals including antipatharian sea whips (genus Cirripathes) and alcyonarian sea fans (families Muricidae and Paramuricidae), what appeared to be hydroids, and scattered crinoids (Echinodermata). Hard bottom areas all supported a wide variety of life forms including bottom-attached sea fans, sea whips, hydroids and sponges. On some pinnacles and major outcrops, solitary hard corals were observed mostly clinging to the undersides of overhangs on the outcrops. Other organisms associated with hard bottom are starfish, echinoids and several types of reeffishes.

Four television transects were run in Area 4. The location of the transects is found in the Navigation Post Plot Map. The observations along these transects are summarized below.

- Transect A-A': Block 473:
  West to east across lines 114 and 115 between shot points 21 and 22.

  Soft bottom sediment with depressions 30 cm across and 30 cm deep contains tracks, trails and small holes (bioturbation) interpreted as signs of benthic organisms. The bottom appeared barren of organisms except for scattered sea whips. In areas of coarser sand, patches of branching organisms (hydroids, sea fans, sponges) and associated starfish and small fish surrounding major outcrops were found. Major outcrops contain encrusting sponges, sea whips, sea fans, echinoids and several types of reeffishes including Serranus? phoebe, Chaetodon aya, Priacanthus sp. and the "Reeffish A" previously reported from the Texas fishing bank (T. Bright, personal communication). The outcrops east of line 114, in addition, exhibited growths of what appeared to be a hard solitary coral.

- Transect B-B': Block 473:
West to east across line 114 at shot point 32.

The fine sand bottom is barren of organisms except for widely scattered single crinoids, sea whips, and groups of small holes (2 to 3 cm in diameter) which are probably associated with sabellid polychaetes. A starfish and sea urchins were seen. Depressions, 30 cm in diameter, scattered along the transect were seen to be occasionally occupied by some benthic fish (e.g., synodontid). Major outcrop areas are surrounded by coarse sand, shell fragments, and attached sea whips, sea fans, and apparent hydroids. The outcrop surface areas are covered up to 50% with solitary hard coral and black encrusting sponge. Reeffish abundance and diversity increased in the vicinity of outcrops. Priacanthus sp. and a single ophiuroid were also noted.

- Transect C-C': Block 562:
North to south along line 108 from shot points 56 to 95.

Areas of fine sand bottom are devoid of attached epifauna. Numerous shallow depressions were seen. Sand dollars (every 10-20 m) may be responsible for depressions in the soft sediment. Occasional holes or clusters of holes, 2 cm in diameter may be the result of polychaete activity. Benthic sea robins (family Triglidae) and hermit crabs were noted.

An increased frequency of larger mounds and depressions (30 cm across and with 30 cm vertical relief) occurs at shot point 80. A carbonate rock outcrop (1 x 2 x 1.5 m) at shot point 87 is covered with veneer of fine sediment and small patches of encrusting sponge. The outcrop is surrounded by a fine sediment bottom. A larger sediment-covered carbonate outcrop (3 x 3 x 3 m) south of shot point 87 has attached sea whips, perhaps a basket star (Echinodermata) and several types of reef-fishes including blue angelfish (Holocanthus bermudensis) and priacanthids. The outcrops are surrounded by fine sediment with patches of sea fans, sea whips and what appeared to be hydroids all attached to the rock outcrops. One ophiuroid was seen on a small outcrop. A thin veneer of sediment is apparent on all outcrops.

- Transect D-D': Block 563:
North to south along line 104 between shot points 69 and 93.

The fine sediment bottom contains no attached epifauna. Eels are quite common on the bottom and partially exposed in burrows. There is little bioturbation. Pinfish, synodontids and red goatfish were seen. An occasional sand dollar was noted. The depth sounder records indicate low relief appearing between shot points 87 and 91. These features were not noticed on video records due to their gentle slope. They may be responsible for the linear features detected by the side scan sonar in this area.

## 12.0 AREA 5: TARPON SPRINGS BLOCKS 233, 234, 277, 278, 279

### 12.1 Location

Area 5 is located 80 km west of Crystal River, Florida. The area is bounded by latitudes 28°39'N to 28°45'N and longitudes 83°18'W to 83°28'W.

### 12.2 Bathymetry

Water depths of Area 5 increase from 17 m on the east side of Block 279 to 22 m at the west-central part of the area in the southwest quadrant of Block 233. The water bottom of the entire area consists of very broad irregular bathymetric highs and lows. The slopes of the water bottom rarely exceed 1 $m \cdot km^{-1}$.

### 12.3 Sea Floor Characterization

The sea floor of Area 5 consists of zones of hard bottom, scattered hard bottom and zones of bedrock covered by a veneer (1-4 m) of unconsolidated sand and shell fragments. The hard bottom areas have numerous highs and lows whose relief is no more than 3 m. Many depressions within these hard bottom zones are suggestive of shallow sinkholes or well shaped cavities in a limestone terrain. These depressions are typically 3-20 m across, although a few are larger. Locally, the hard bottom zones appear to have fine grained textures on the side scan records with highs and lows separated by only 2-3 m. The scattered hard bottom areas are very similar to the hard bottom areas in appearance but differ in the density and relief of highs and lows.

The hard bottom targets are interpreted as areas of bedrock outcrops; varying amounts of unconsolidated sediment cover result in scattered outcrops or a featureless soft sediment bottom. Locally, bottom textures observed on the side scan sonar records suggest that benthic currents are strong enough to form sand ripples and dune-like features 1-2 m high and 5-10 m across.

### 12.4 Sub-Bottom Geology

All of Area 5 appears to be underlain by hard limestone bedrock. The 3.5 kHz sub-bottom profiler shows minor penetration in Blocks 233 and 234 but little or no penetration in most of the southern blocks. The lack of penetration by the 3.5 kHz profiler in the hard bottom areas suggests that the bottom is without sediment cover or that the thicness of the sediment cover is less than the resolution of the profiler. The UNIBOOM records indicate the hard bottom zones are underlain by irregular reflectors whose form is reminiscent of carbonate solution cavities (karst features). From these data and comparisons of similar textured zones in Areas 6, 7 and 9, the hard bottom zones are interpreted to be carbonate outcrops. Some limestone ledges were photographed during the BLM surveys (BLM, 1978). Continuous outcrops are found in the south of Blocks 277, 278, and 279 and in the southeast quadrants of Block 234.

The 3.5 kHz sub-bottom profiler and UNIBOOM profiler both penetrated thin semiconsolidated or unconsolidated sediments in the soft bottom areas. The UNIBOOM records show that up to 4 m of sediment overlies the hard reflectors. These reflectors are exposed at the sea floor in troughs. Most of the sediment

covered bedrock is located in Blocks 233, 234 and the northern part of Block 277. Some of the soft bottom areas in Blocks 278 and 279 may have sediment cover too thin for the sub-bottom profilers to detect.

## 12.5 Biological Associations

No ground truth data were gathered during this investigation because the area had been previously studied (BLM, 1978). However, in accordance with the findings in Areas 6, 7 and 9, and from general associations observed from the BLM survey, the hard bottom and scattered hard bottom areas of Area 5 contain soft and hard corals, sponges, gorgonians, and many species of reeffishes. The extensive bottom outcrops support a fairly high density biological community comparable to the densities found on carbonate rubble and calcareous outcrops of Areas 6 and 9 (*i.e.*, 40-50% of the bottom). The soft bottom areas support some attached epifaunal assemblages where the veneer of sediments is locally very thin. The BLM survey reported seagrass (*Halophilia*) and algae (*Caulerpa* and *Udotea*) in these areas.

## 13.0 AREA 6: THE ELBOW BLOCKS 567, 609, 696, 697

### 13.1 Location

Area 6 is located approximately 149 km southwest of the entrance to Tampa Bay. It is bounded by latitudes 27°15'N and 27°27'N and longitudes 84°00'W and 84°12'W. This area encompases approximately 16 Blocks, only 4 of which were part of this study.

### 13.2 Bathymetry

Water depths in Block 567 range from 64 m in the east to 72 m in the west. The bathymetric contours generally trend north-south and form a broad dome in the eastern portion of the area. West of the 68 m contour line the water bottom drops across a small escarpment that is about 4 m high and trends north-south.

Water depths in Block 609 range from 77 m in the northeast corner to 84 m in the south central portion of the block. The bathymetric contours trend north-northwest throughout the area. The western portion of the area is characterized by a broad high with 1-2 m of relief.

Water depths in Blocks 696 and 697 range from 83 m on the eastern portion of Block 697 to a maximum of 96 m in the southwest portion of Block 696. The eastern edge of Block 697 is bordered by a north-south trending scarp. A broad depression and a broad high occur in the central portions of Block 697 and the eastern portions of Block 696 respectively. This zone of broad irregular bathymetry has a maximum relief of 3-4 m between the deepest and shallowest points. The remaining western portion of Block 696 has a water bottom which slopes gently to the southwest at approximately $3 m \cdot km^{-1}$.

### 13.3 Sea Floor Characterization

In Block 567 the sea floor is characterized by a smooth sandy bottom with small (5-15 cm wide) irregularly distributed mounds and depressions. Occasional zones of coarse bottom which contain carbonate rubble and small outcrops are concentrated in the northern and western portions of the block. The scattered hard bottom outcrops in this area typically have a relief of $<0.5$ m and exposed surface area of $<1\ m^2$. The largest outcrop identified in this block has relief of approximately 2 m and a surface area of approximately $2\ m^2$.

The sea floor of Block 609 is generally a smooth, soft bottom with evidence of bioturbation. In the northwest and southeast portions of Block 609 there are scattered zones of low relief (1-2 m) mounds which appear to be 15-20 m across. These zones of mounds have been mapped as scattered hard bottom areas. There is no evidence that they are due to biological activity and we cannot confirm that they are outcrops. One possible explanation is that they are shallow outcrops covered by a layer of sand.

Blocks 696 and 697 contain a smooth sandy bottom with only minor evidence of bioturbation interpreted from the side scan sonar records. Small zones of mounds and depressions are seen in the southeast portion of Block 697. These zones generally do not exceed 20-30 m across. The remaining area of these

blocks appears devoid of side scan sonar targets.

## 13.4 Sub-Bottom Geology

Three separate cross sections are shown for Area 6 because the blocks are not contiguous. These cross sections are presented on Sheet 2 of the Geologic Cross Sections. In each of the 3 areas the bottom sediments consist primarily of a thin layer of unconsolidated fine-grained calcareous sand with occasional zones of bottom rubble. Occasional outcrops of biogenic carbonate are probably the source of the scattered rubble. In Block 567 the sub-bottom profile records indicate the presence of a hard bottom immediately beneath the thin veneer of sand. In places this veneer of sand is probably no more than 10-20 cm thick. The thin veneer of sand appears to be underlain in the eastern portion of this block by as much as 4 m of unconsolidated or semiconsolidated sediments. Occasional cross-bedding suggests that these sediments are predominently sand. Several strong reflectors underlie the semiconsolidated sediments and can be mapped across the block down to a depth of approximately 35 ms. All of these reflectors dip very gently to the west.

In Block 609 the 3.5 kHz sub-bottom profiler generally achieved from 1-3 m of penetration and occasionally up to 5-7 m, indicating a fairly extensive blanket of unconsolidated sediments throughout the area. Little or no penetration was achieved in the areas which have been mapped as scattered hard bottom zones. The UNIBOOM records indicate that the shallow sub-bottom reflectors consist of undistributed sediments which dip gently to the west, parallel to the sea floor. The cross section for Block 609 shows an anomaly at shot point 31 in one of the sub-bottom reflectors. At this point the strong reflecting horizon has either been eroded by channeling or a solution cavity has formed and has been filled in by the overlying sediments. If the feature is a solution cavity it may indicate that limestones occur at very shallow depths in this area.

In Blocks 696 and 697 the 3.5 kHz sub-bottom profiler achieved sufficient penetration to indicate a relatively soft sediment bottom with a thickness of 2-5 m over most of the area. The UNIBOOM records indicate that most of the bottom is underlain by 10-20 ms of flat-lying sediments resting on a strong reflector that prevents clear definition of deeper reflections. This strong reflector is irregular in profile but is underlain by occasional flat-lying reflectors. This configuration suggests that the strong reflector may be an erosional disconformity.

## 13.5 Biological Associations

The most common bottom category in Area 6 is the featureless, soft sand bottom. Generally these zones appear relatively barren except for burrows and small holes. Some scattered Caulpera-like algae, urchins (probably genus Slytacidaris), small paramuricid sea fans and occasional star fish were seen in the ground truth transects.

In Block 567 the scattered hard bottom and hard bottom areas were observed by videotape transects. These habitats included associations of upright vase-like sponges (probably genus Ircinia), green, Caulepra-like algae and encrusting coralline algae in the sandy areas. Some outcrops supported soft corals such as paramuricid sea fans, branching antipatharian corals, sea whips

(Cirripathes sp.), and an array of encrusting sponges and algae. Associated fishes include yellowtail reeffishes (Chromis enchrysurus), tattlers (Serranus phoebe) and cardinal fishes. Urchins (probably genus Diadema) and starfish are also seen scattered among the outcrops.

Blocks 609, 696 and 697 appear to be 90-95% soft sand bottom. A transect in Block 609 indicated widely scattered depressions up to 1 m across which were sometimes occupied by tilefish. Occasional sea robins (family Triglidae), eels (families Ophichthidae and Ophidiidae), synodontid lizard fish, anemone, crinoids, (family Echinodermata), and sponges (genus Neofibularia) also inhabit the sandy bottom.

Three ground truth transects were run in Area 6. The locations of the transects are shown on the Navigation Post Plot Map. The observations are summarized below:

- Transect A-A': Block 567:
  East to west across line 101 at shot point 5.

  The sediment is chiefly a fine calcareous sand. Scattered over 30-50 % of the bottom are minor outcrops of hard bottom with areas of accumulated rubble, upright sponges (perhaps Neofibularia and Ircinia), encrusting sponges and algae, and various reeffishes including bigeyes (family Priacanthidae) and serranid basses (probably Serranus phoebe). Organisms associated with the sand around the outcrops include starfish (perhaps Narcissia trigonaria), a green alga similar to Caulpera, and what appears to be a green calcareous alga. An outcrop of low relief which covered about 2 $m^2$ showed greatest diversity and abundance of plants and animals. Encrusting and vase-like sponges, purple coralline algae, yellowtail reeffishes (Chromis enchrysurus) and perhaps a type of branching bryozoan were seen.

- Transect B-B': Block 567:
  West to east across line 101 at shot point 31.

  The sediment is fine calcareous sand. Scattered throughout the sand areas are blocks of hard rubble with encrusting sponges, pieces of green, Caulerpa-like algae, and occasional vase-like sponges (probably genus Ircinia). Areas of low-relief outcrops are found just west of line 101. As much as 70% of the bottom is covered with rubble and attached fauna. Vase-like and encrusting sponges are abundant along with encrusting coralline algae. Larger outcrops (1-2 m of vertical relief) contained the array of encrusting organisms seen on minor outcrops and exhibited types of soft corals including paramuricid sea fans, branching antipatharian corals and some sea whips (Cirripathes sp.). Reeffishes associated with hard-bottom outcrops included Priacanthis bigeyes, yellowtail reeffishes, tattlers (Serranus phoebe), and cardinal fish. Sea urchins (probably genus Diadema) and starfish were also seen on and around the outcrops. To the east of line 101 the sediment was less coarse. Burrows and small holes were more evident and Caulpera-like algae was scattered throughout the area. Urchins (probably genus Sylocidaris), a squid (Loligo sp.), small paramuricid sea fans, and occasional starfish (Narcissia sp.) were seen.

- Transect C-C': Block 609:
  East to west across line 101 between shot points 25 and 26.

  There was no evidence of hard bottom outcrops on the videotapes. The bottom is flat and monotonous and composed of fine sand. Sonar targets interpreted as large depressions are seen scattered along the transect. One tilefish was seen associated with a 0.5-1 m diameter hole. An occasional sponge (perhaps genus Neofigularila) and what looked like an anemone were seen. One crinoid was seen in association with the sponge. Other organisms observed widely scattered over the bottom included: several eels (probably family Ophichthidae); synodotid lizard fish; a portunid crab; some type of hake (family Gadidae); a cusk-eel (family Ophidiidae); several types of sea robins (family Triglidae); and a starfish. Small holes in the sediment (5-10 cm in diameter) may result from eel or epibenthos activity. A high degree of bioturbation was observed in the form of tracks (eel) and small holes.

## 14.0 AREA 7: SAINT PETERSBURG BLOCKS 661, 662, 705, 706

### 14.1 Location

Area 7 is located approximately 117 km southwest of the entrance to Tampa Bay. It is bounded by latitudes 27°12'N and 27°18'N and longitudes 83°54'W and 84°00'W.

### 14.2 Bathymetry

The depth of water in Area 7 ranges from 66 m at the northeast corner to about 76 m at the southwest corner. The bottom surface is somewhat irregular but the contours trend north to northwest and the surface slopes toward the west and southwest. Several large, broad, relatively flat areas are present in the central portion of the area.

### 14.3 Sea Floor Characterization

The sea floor surface in Area 7 consists of fine to coarse poorly sorted carbonate sands and localized low-relief limestone outcrops. The sandy areas are relatively flat and smooth with minor surface relief in the form of small mounds and depressions. The mounds and depressions are generally measureable in tens of centimetres of relief and <1 m in diameter. Outcrops generally occur in the form of low-relief gently sloping mounds that border steep-sided depressions. Relief of the mounds is generally 1-5 m. The depressions have a general relief ranging from 10 cm - 1 m. The outcrop areas (hard and scattered hard bottom areas) are primarily located in the west-central, southern and northeastern parts of Block 661, the northeastern and north-central parts of Block 705, the southern part of Block 662 and throughout Block 706.

### 14.4 Sub-Bottom Geology

The thickness of the unconsolidated sandy material interpreted from the sub-bottom profile data ranges from a thin veneer, overlying and partially covering the limestone outcrops, to 1-4 m where outcrops are absent. No data are available on the material below the unconsolidated sands. However, from the UNIBOOM data it is inferred that the units are probably limestones. Sub-bottom mappable horizons indicate that these units are nearly horizontal with a gentle slope toward the west. A cross section from line 205 across Blocks 661 and 662 is shown on Sheet 3 of the Geologic Cross Sections.

### 14.5 Biological Associations

Biological communities in the soft bottom areas are sparse to widely scattered and consist of attached hydroids, bryozoans, sponges or coralline algae and echinoids (*Diadema*). A variable number of small tube like openings were observed in the sandy areas and probably represent sabellid polychaete tubes. A few antipatharian sea whips (*Cirripathes*) were also observed. Fishes associated with the smooth sandy bottom areas included a few scorpion fish (family Scorpaenidae), batfish (family Ogcocephalidae) and synodontids.

Biota associated with the hard bottom and scattered hard bottom areas consist of attached and encrusted sponges, branching structures (possible calcareous

algae), muricid and paramuricid sea fans, antipatharian sea whips and starfish. Fish varieties include bandtail puffer fish (Sphderoides spengleri), groupers and creole fish (family Serranidae), priacanthids, serranids, yellow tail reeffish (Chromis enchrysurus), and file fish (family Balistidae).

A summary of the biological observations of the TV transect is given below. The location of the transect is shown on the Navigation Post Plot Map.

- Transect A-A': Blocks 661 and 662
  West to east along line 205 from shot points 55-0

  The bottom sediments are fine to coarse. Sponges and branching structures (possibly calcareous algae) were noted on the videotape. The bottom contains scattered depressions up to 50 cm across with calcareous algae, sponge, or hard rubble. Patterned holes may indicate polychaete presence.

  A low-relief outcrop (2 m across) contains yellow sponge, possibly basket stars (family Echinodermata) and an increased diversity of fish including a grouper and perhaps a creole fish (family Serranidae). A second outcrop covered with muricid and paramuricid sea fans and encrusting sponges was noted between shot points 48 and 50. A basslet (Liopropoma eukrines) was observed at the second outcrop.

  The sediment around the outcrops appears coarse with scattered patches of calcareous algae, starfish (genus Narcissia), sponges (probably Spongia) and several bandtail pufferfish (Sphoeroides spengleri).

  East of the outcrop area, the sediment becomes finer grained than previously observed and the density of organisms decreases. At most, 5% of the bottom is covered with attached hydroids, bryozoans, sponges or coralline algae in small patches. Fishes associated with the soft bottoms included a scorpion fish (family Scorpaenidae), a batfish (family Ogcocephalidae), and synodontids. Other organisms widely scattered over the area included echinoids (Diadema), sabellid polychaete tubes, and an antipatharian sea whip (Cirripathes).

  Between shot points 25 and 12, the frequency of patches of sponges, and other attached invertebrates increases suggesting a greater abundance of near surface hard bottom. Associated with the patches were reeffishes including priacanthids, serranids, the yellowtail reeffish (Chromis enchrysurus) and filefish (family Balistidae). The sediment appeared to be coarse carbonate sand. East of shot point 12 the sediment is fine grained, and small mounds and depressions are evident. Sand dollars become more abundant whereas the density of attached sponges, calcareous algae and rubble decreases in the fine grained soft bottom area.

## 15.0 AREA 8: SAINT PETERSBURG BLOCKS 753, 754, 797, 798

### 15.1 Location

Area 8 is located approximately 108 km southwest of the entrance to Tampa Bay. It is bounded by latitudes 27°07'N and 27°13'N and longitudes 83°42'W and 83°48'W.

### 15.2 Bathymetry

The water depth varies from 53 m in the northeast corner of Block 754 to 60 m in the southwest corner of Block 797. The central portion of the area is broad and flat with gentle slopes to the west in Blocks 753 and 797 and to the southeast in Block 798.

### 15.3 Sea Floor Characterization

The sea floor surface in Area 8 appears to consist primarily of a soft bottom veneer of unconsolidated sediments with only a few scattered outcrops along the eastern margin of Block 798. The unconsolidated sediments probably consist of sand and finer grained material. Low amplitude, short wavelength ripples are present throughout the sediment covered areas. The presence of the small ripples over most of the bottom surface indicates that fairly active bottom currents exist in Area 8. A few large, low-relief depressions covering an area of about 10-25 m are also present in the eastern part of Block 754 and eastern and southeastern parts of Block 798.

### 15.4 Sub-Bottom Geology

The unconsolidated sediments appear to be 1-3 m thick throughout the area. Several mappable horizons are seen beneath the unconsolidated sediments on the UNIBOOM records. These sediments are probably semiconsolidated to consolidated sands. Several buried channel-like features are seen within the area. The shallow reflecting horizons dip gently to the west-southwest. A cross section is shown on Sheet 3 of the Geologic Cross Sections.

### 15.5 Biological Associations

No videotape transects or other bottom sampling was conducted in Area 8 and therefore no direct data regarding the biological communities in the area are presented in this report.

The density of biological assemblages associated with the bedform area is probably sparse and may consist of occasional sea whips, hydroids, bryozoans, and possibly a few sponges and soft corals. Biological assemblages associated with the hard bottom areas found in Area 7 are probably also present around the scattered hard bottom areas in Block 798. These assemblages include assorted sea whips, sponges, corals, sea fans, and a variety of fishes.

## 16.0 AREA 9: CHARLOTTE HARBOR BLOCKS 143, 144, 145, 187, 188, 231

### 16.1 Location

Area 9 is located approximately 118 km west of the entrance to Charlotte Harbor. It is bounded by latitudes 26°42'N and 26°50'N and longitudes 83°22'W and 83°30'W.

### 16.2 Bathymetry

The depth of water in Area 9 ranges from 52 m in the northeastern corner of Block 145 to about 58 m in the southwestern and western parts of Blocks 187 and 231. The irregular bottom surface slopes gently to the west and southwest. It is relatively flat with major features consisting of broad highs and associated troughs that have a relief of 1-2 m. The general trend of the highs and lows is east to west in the northern half of the area, and northeast to southwest in the southern half of the area. Localized large circular to elliptical depressions are present in the southeast portion of Block 143 and the central part of Block 188. One large elongated east-west trending depression is located in the center of Block 143.

### 16.3 Sea Floor Characterization

The sea floor in Area 9 consists of both hard and soft bottom occurring in irregular patches. Major hard bottom or scattered hard bottom areas occur in the northern Blocks, 143, 144 and 145 and in the central Block 188.

The unconsolidated sediments consist of fine to coarse sands and silts with cobble-size limestone fragments. Bedforms occur in the coarser unconsolidated sediments over large portions of Blocks 187, 188, and 231. Small mounds and depressions with relief of 1 m or less and a surface area 1-15 $m^2$ occur throughout the soft bottom areas. The unconsolidated sediment cover thins to the north and east where large areas of scattered hard bottom and hard bottom have been mapped. The hard bottom outcrops occur in 2 forms: as scattered outcrops surrounded by and almost completely covered with a veneer of sediments or as ledges which are exposed along the edges and at the base of small depressions.

### 16.4 Sub-Bottom Geology

The unconsolidated sediments at the sea bottom range in thickness from 1-4 m. No data is available on the material underlying the surface unconsolidated sediments; however, based on nearly horizontal reflective horizons from the records and the wide occurance of local surface outcrops, the underlying material is probably limestone. A cross section from UNIBOOM line 205 across Blocks 143, 144 and 145 is presented on Sheet 3 of the Geologic Cross Sections.

### 16.5 Biological Associations

The biological assemblages in Area 9 visible on the videotapes and 35 mm slides obtained during the 2 transects can be divided into 3 categories that are associated with soft bottom sediment areas, bedform areas, and hard and scattered hard bottom areas. Although the biological habitat observed is from

a small part of Area 9 (2 transects) the same or similar biological communities associated with the bottom surface types observed during the videotape transect probably represent the biological communities present with corresponding surface types in the remainder of Area 9.

The biota observed in the soft bottom areas consisted of a thin veneer of mat-like algae covering the sediment and small holes and depressions interpreted as sabellia polychaete feeding apparatus. The primary biota in this area was a large population (up to $30 \cdot m^{-2}$) of scallops. Also observed were scattered small sponges. In the ripple covered areas, the biological assemblages include tubular sponges and limestone fragments with encrusting sponges. Scattered antipatharian sea whips are also present.

The observations over outcrops and over the scattered hard bottom areas showed a diverse fauna that included soft coral (sea fans and whips), sponges (tubular and encrusting) calcareous encrusting and branching algae. In addition, a variety of fish types was observed in this bottom area. These include bandtail puffer, sea robins, spotfit butterfly fish, blue angel fish, squirrel fish, grunts and grouper. The fishes tend to congregate in large numbers in the vicinity of hard bottom outcrops with a relief of >1 m.

A summary of the biological observations of the 2 TV transects is given below. The location of the transects is shown on the Navigation Post Plot Map.

- Transect A-A': Block 145:
  West to east, 75 m north of line 201 between shot points 21 and 15.

  The sea floor at the western end of the transect is composed of fine sand with a greenish-brown mat (algae) and with 2-3 cm diameter holes. Apparatus extending from several holes were retracted upon approach of the camera system and extensions were interpreted as sabellid polychaete feeding apparatus. Occasional sponges were encountered. A large population (up to $30 \cdot m^{-2}$) of calico scallops (Argopecten gibbus) was encountered between shot points 22 and 18.

  One carbonate outcrop area, 1-2 $m^2$, was seen. Associated with the outcrop were several types of fishes including snappers (family Lutjanidae), a starfish, an urchin, and several encrusting types of organisms (i.e., sponges).

  A calcareous sand area with ripple marks approximately 30 cm high and 1 m apart was interpreted as causing the linear striations seen on side scan sonar records. Sponges and hard rubble were found in the troughs of these ripples and an area of concentrated antipatharian sea whip growth was noted.

- Transect B-B': Block 145
  West to east, 30 m south of line 201 between shot points 7 and 0.

  The sea floor at the west end of the transect is a fine calcareous sand. The bottom is void of identifiable organisms except for algae mat, isolated sponges and probably polychaete feeding apparatus. At shot point 7, ripples were found. Some rubble (calcareous) and sponges were apparent in the troughs. In the midst of the rippled area a large

depression (1 $m^2$ and 50 cm deep) was noted with a snapper (family Lutjanidae) swimming about.

The area east of shot point 7 has a high diversity of attached organisms (up to 50% of the bottom) including loggerhead sponges, antipatharian sea whips (genus Cirripathes), and tubular sponges (perhaps Ircinia). Calcareous rubble is encrusted with various sponges and algae. Branching sponges and calcareous algae are present. Several types of reeffishes are found associated with large sponges and rubble areas including: bandtail puffer (Sphoeroides spengleri); sea robins (family Triglidae); spotfin butterflyfish (Chaetodon ocellatus); blue angelfish (Holocanthus bermudensis); Chromis-like fish; squirrelfish (family Holocentridae); grunts (family Pomadasyidae); and a grouper (family Serranidae). The fishes tend to congregate in large numbers around carbonate outcrops with 1 m or more relief.

## 17.0 AREA 10: CHARLOTTE HARBOR BLOCKS 583, 584, 627, 628, 671, 672, 715, 716

### 17.1 Location

Area 10 is located approximately 117 km southwest of the entrance to Charlotte Harbor. It is bounded by latitudes 26°13'N and 26°25'N and by longitudes 83°24'W and 83°30'W.

### 17.2 Bathymetry

The water depths range from 58 m in the northeast portion of Block 584 to 63 m in the southwest portion of Block 715. The water bottom slopes gently to the southwest at approximately 0.4 $m \cdot km^{-1}$. Contour lines in Blocks 715 and 716 are dashed to indicate they are based on USGS Hazard Survey Data.

### 17.3 Sea Floor Characterization

Side scan sonar records indicate that the sea floor in Area 10 is covered with sand. Over 80% of the area contains bedforms with several tenths of a metre of relief and wavelengths of 1-3 m.

Larger bedforms, commonly 10-20 m in wavelength and 1 m high, occur randomly across the area.

### 17.4 Sub-Bottom Geology

The sub-bottom horizons parallel the sea floor and dip gently to the southwest. They are generally planar with the exception of a strong reflector which occurs within several milliseconds of the bottom and shows occasional channel features. A strong reflector is seen throughout the area at a depth of 25 ms beneath the sea floor. This reflector acts as an acoustic basement to the high-resolution sub-bottom profilers.

### 17.5 Biological Associations

No ground truth survey was conducted in Area 10 because of the lack of hard bottom areas. The soft bottom community can be inferred from the transects in the soft bottom portions of Areas 6, 7, and 9.

## 18.0 RECOMMENDATIONS

### 18.1 Basis for Recommendations

The ground truth data and the geophysical survey maps were used to identify potentially critical marine habitat areas where further studies may be desired prior to initiating offshore operations that could affect the marine habitat. Such additional studies could be undertaken as part of a lease block stipulation as presented in Section IV.D.8 of the DES (BLM, 1978).

The following criteria were used to identify which lease blocks or portions of blocks possibly required additional study:

- The identification of a locally unique marine habitat, expecially one of limited surface extent or very high biotic productivity.

- The identification of a biological assemblage that appears to have a limited or confined distribution. A local impact on the environment could have a large impact on the population because of its limited distribution.

- The identification of an area where there is not a sufficient data base to document the nature of the habitat or the benthic community.

A summary of the study results is presented below for each of the 10 survey areas. Recommendations for further study have been made for portions of 5 of the areas. The reasons for the recommendations are varied and are discussed individually.

It must be emphasized that a recommendation of "Further study not recommended" does not imply that the area is not a prime resource to be protected. This recommendation only implies that the area is not a unique marine habitat and that there appears to be a sufficient data base for making decisions regarding necessary protective measures.

The existing data base required that the ground truth portion of this study be concentrated in the more unique "hard bottom" areas of the lease blocks. The majority of the lease blocks studied are "soft bottom" areas. Most of the observed biotic activity is associated with the soft bottom. The soft bottom varies considerably in character and biotic productivity. These areas represent a prime resource and must be considered in proper perspective before any judgements about the ecological or economic impacts of the lease sale can be made.

### 18.2 Recommendations and Summary of Results

AREA 1: Pensacola Blocks 884, 928, 972
Destin Dome Block 4
Further study not recommended.

No hard bottom areas were mapped in this area. No ground truth transects were conducted in this area and the recommendation is based on observations of similar soft bottom habitats in Area 2.

AREA 2: Destin Dome Blocks 313, 314, 357, 358
Further study not recommended.

The side scan sonar anomalies investigated in Area 2 were found to be due to textural changes in the sea floor sediment that varied from a fine mud to a poorly sorted sand with shell fragments. Features with relief of 1-3 m were uncommon and a veneer of sediment covered the 2 observed outcrops. The soft bottom was devoid of attached epifauna or flora. Infauna predominated the benthic assemblages, and demersal fish were widely scattered. Turbidity was high, which accounts for the sediment veneer and contributes to the lack of attached organisms.

AREA 3: Destin Dome Blocks 529, 573, 574, 618, 661, 662
Further study recommended in areas of carbonate outcrops.

Area 3 contains two areas of extensive carbonate outcrops; the northern portion of Blocks 573-574 in water depths of 72-90 m, and the northwest portion of Block 661 in a water depth of 115 m. In these areas individual pinnacles may rise up to 12 m above the surrounding sea floor. The sea floor was covered with fine sediment and was devoid of epifaunal organisms. A veneer of sediment also covered the outcrop structures. It was this sediment veneer which seemed to preclude the development of a substantial attached epifaunal community. A few coral were observed on the underside of ledges where the sediment layer was absent.

Although luxuriant epifaunal assemblages were not observed in the transects, further study of Area 3 is recommended in the pinnacle areas for two reasons: First, the procedure of towing or drifting a TV and camera from a surface vessel is quite precarious in an area of such extreme relief. Several times the camera sled was caught on outcrops. As a consequence the survey was limited largely to observations around the tops of pinnacles, and little data could be obtained throughout the full extent of these pinnacles without considerable risk of losing equipment. Other means of observation may be desirable in these areas. Second, the pinnacle area mapped from the side scan sonar is extensive and our ground truth survey was limited to a few transects.

Area 4: Destin Dome Blocks 473, 474, 518, 519, 562, 563
Conditional recommendation for further study in limited areas.

The majority of Area 4 exhibited a fine sand bottom, crossed by trails and other evidence of bioturbation. Outcrops and attached organisms were sparse. Many mobile fish were observed living on the soft bottom and associated with holes or burrows. Local carbonate outcrops in Blocks 474, 518 and 563 supported more diverse assemblages of attached fauna and reeffishes. Floral and faunal coverage on the observed outcrops approximated 50%, and a fine sediment veneer was apparent. Further study in Area 4 is recommended only in the mapped areas of extensive carbonate outcrops.

AREA 5: Tarpon Springs Blocks 233, 234, 277, 278, 279
Further study recommended.

No ground truth survey was conducted in this area because of the previous diver transects conducted for the State of Florida. The results of these studies are reported in Bureau of Land Management (1978). This study recommended safeguards, in the form of lease stipulations requiring further geophysical studies and photodocumentation of benthic communities at proposed drillsites.

AREA 6: The Elbow Blocks 567, 609, 696, 697
Further study recommended for Block 567

Block 567 contained numerous small carbonate outcrops. Attached plants and animals covered approximately 40-50% of the outcrops. Reeffish were common around the outcrops.

The remaining blocks in Area 6 are flat and contain a soft bottom. The bottom consisted of fine sand which was barren with respect to epifauna over 90-95% of the area. The only features observed were occasional sponges and depressions frequented by benthic fish.

AREA 7: Saint Petersburg Blocks 661, 662, 705, 706
Conditional recommendation for further study in limited areas.

Mapped areas of scattered hard bottom occur in all four blocks. Calcareous algae and sponges predominate the epifauna but considerable diversity in benthic communities was observed in these areas. Individual outcrops are limited in extent and should be mapped at a larger scale.

Where the soft bottom is mapped, the bottom sediments are fine sand and the density of epifauna is sparse.

AREA 8: Saint Petersburg Blocks 753, 754, 797, 798
Not recommended for further study.

No ground truth survey was conducted in Area 8. The side scan sonar and sub-bottom profile records indicate a flat, sandy bottom with 1-3 m of fine sand over a hard reflector. Scattered hard bottom appears to crop out only in the southeastern portion of block 798.

AREA 9: Charlotte Harbor Blocks 143, 144, 145, 187, 188, 231
Further study recommended in hard bottom areas.

Area 9 exhibited the greatest range of substratum type, faunal abundance and diversity. The bottom type ranged from mud to coarse carbonate rubble with calcareous outcrops of up to 2 m in relief. Accordingly, the epifaunal assemblages ranged from depauperate to diverse with several species of reeffish, sponges and coral typifying the carbonate outcrop zones. In addition, scallops (probably Argopecten gibbus) were observed exclusively in the northeast portion of Block 145 at concentrations approximating $30 \cdot m^{-2}$.

AREA 10: Charlotte Harbor Blocks 583, 584, 627, 628, 671, 672, 715, 716
Not recommended for further study.

No ground truth survey was conducted in Area 10. The geophysical records indicate a monotonous sandy bottom and no bedrock outcrops were mapped. Numerous small mounds and depressions are interpreted from the side scan sonar records and may indicate an abundant soft bottom biota. Side scan sonar textural anomalies may be indicative of an algae mat.

## 19.0 REFERENCES

Data from the following Department of Interior studies for Lease Sale 65 and Lease Sale 41 were utilized in the preparation of this report.


1. BBN-Geomarine Services Company, 1975, Geologic Hazards Survey, OCS Sale #41, Map Sheet Tampa West No. 1, Maps submitted to U.S. Geological Survey.

2. Bureau of Land Management, 1978, Final Environmental Impact Statement, Proposed 1978 Outer Continental Shelf Oil and Gas Lease Sale Offshore Eastern Gulf of Mexico, OCS Sale #65, 2 Vols.

3. Intersea Research Corporation, 1978, Technical Report of High-Resolution Marine Geophysical Survey, Part II Area (OCS Sale No. 65), Prepared for U.S. Geological Survey under Contract No. 14-08-0001-16534.

4. State University System of Florida, 1977, Baseline Monitoring Studies Mississippi, Alabama, Florida Outer Continental Shelf, 1975-76, Prepared for Bureau of Land Management under Contract No. 08550-CT5-30, 5 Vols.

# APPENDIX A

# APPENDIX A

## EQUIPMENT SPECIFICATIONS

Specification sheets are provided for each of the major items of equipment utilized during the geophysical and ground truth cruises. The specifications are provided in the following order:

M/V Sea Transporter

Decca Hi-Fix Navigation System

Raytheon Model DE719B Depth Sounder

EDO Model 4034CM Precision Survey Depth Recorder

Klein Model 530 Side Scan Sonar/Sub-Bottom Profiler

EG&G UNIBOOM

Hydro Products Model TC125 Underwater Television Camera

Model SC303 TV System Control Unit

Model L7 Series Underwater Lights

Benthos Model 373 Deep Sea Standard Camera

Model 382 Deep Sea Standard Flash

# M/V SEA TRANSPORTER

VESSEL
M/V SEA TRANSPORTER (converted YF)
133' length; 31' beam, and 9' draft

HOME PORT DOCK FACILITIES
Port Arthur, Texas

CREW
Experienced Gulf of Mexico Crew

OWNERS
Sea Transporter Associates, Santa Barbara, California

MAIN ENGINES
Two 268A General Motors diesel engines, 500 H.P. each; cruise 10 knots survey speeds at 5 to 6 knots; 24 hours per day operation, 22-24 days per month; and, capability of operating in seas up to eight feet.

GENERATORS
One 6-cyl. Cummins Diesel engine, 30 K.W. - D.C.
One 6-cyl. Cummins Diesel engine, 60 K.W. - D.C.
Two banks of 6-volt batteries with charger
One Motor Generator D.C. to A.C., 25-30 K.W.

CARGO WINCH AND BOOM
One 5-1/2 ton cargo winch with double drum and capstan

ANCHOR GEAR
One 1000# Navy anchor with 720 feet of 1-inch chain
One 500# back up anchor

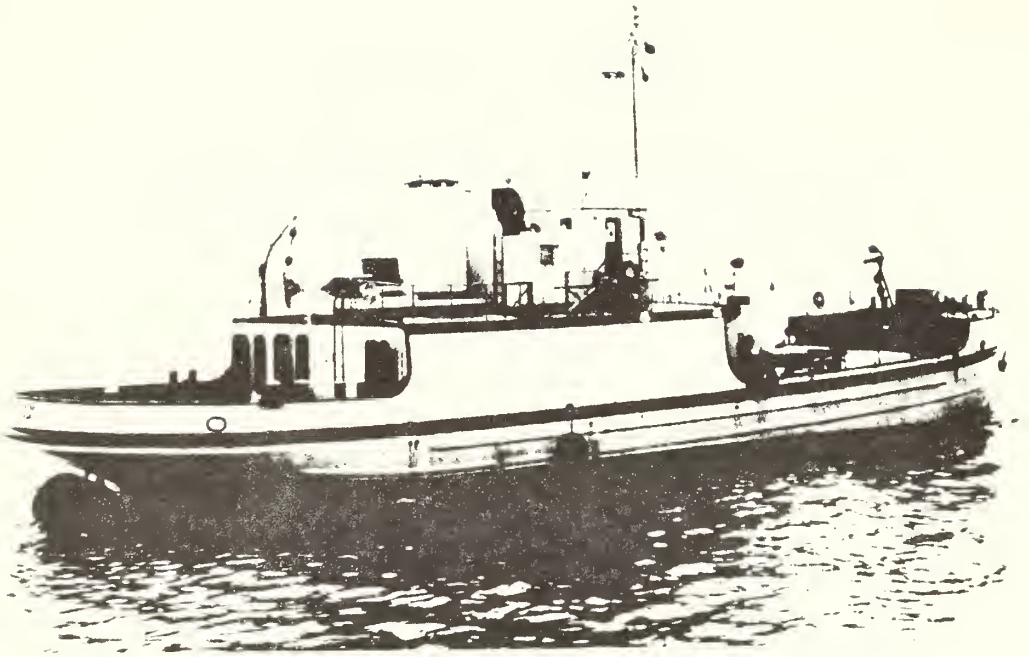
LIFE BOAT
One 20-man life boat

QUARTERS
Sixteen people (including accommodations for 4 client representatives)

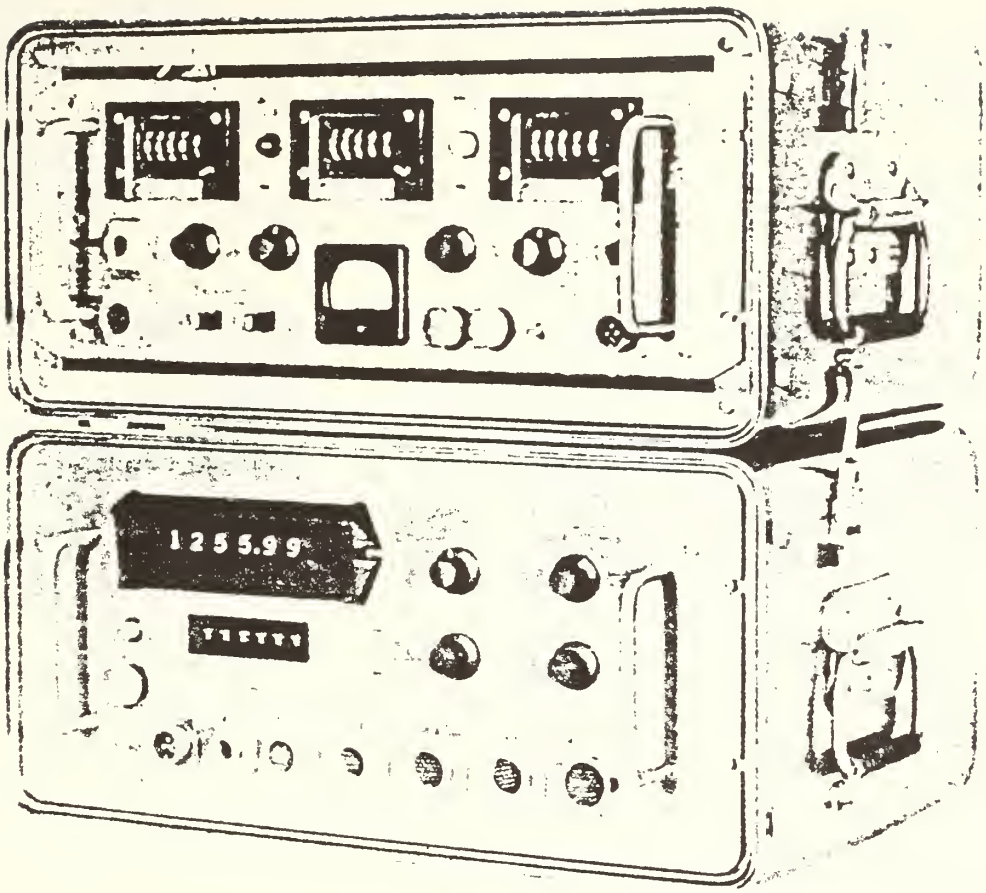
FUEL AND WATER
16,000 gallons of diesel
6,300 gallons of water

CARGO HOLD
350 tons

ELECTRONIC EQUIPMENT AND SERVICES
Shipboard equipment:
Konel Radar, Donel VHF Radio, Sperry Auto Pilot, Northern Single Sideband Radio, Sperry Gyro, Raytheon Fathometer, Kelvin-Hughes Loran A.C.



Sea Transporter: 133' Length, 31' Beam




HI-FIX Chain Stations are designed for unattended operation. All units e easily handled by one man and are mounted in rugged field cases measuring 20 / 14 / 10 inches. Units are designed for stacking during operations.

All Transmitters, Slave and Shipboard Receivers are interchangeable for flexibility and economy. Numerous optional display services are available.

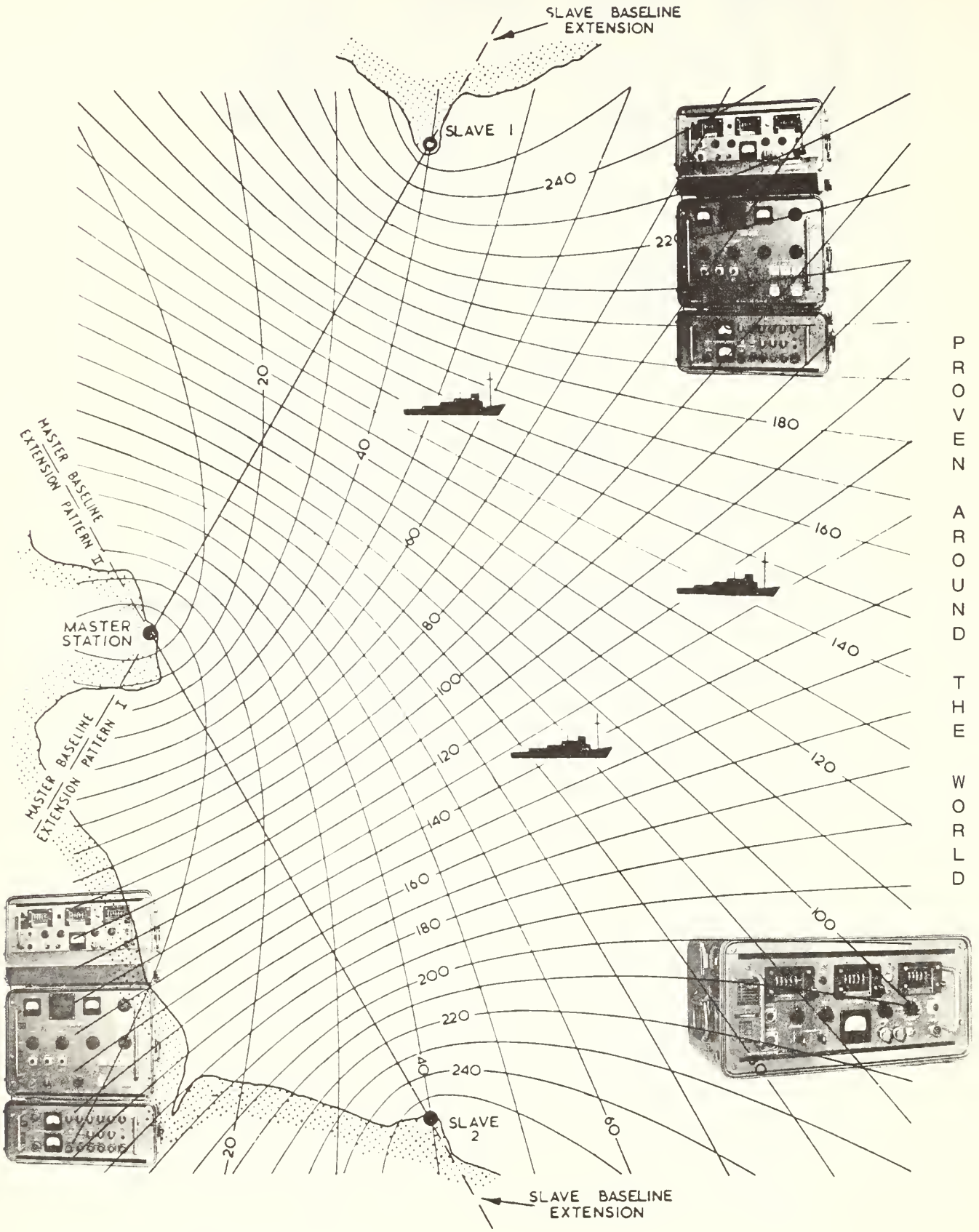
---

| | |
|---|---|
| Operating Frequency ($f_o$) | selected frequency within 1600-2000 KC Band. |
| Control Frequency | $F_o$-60 Cycles |
| Receiver Band Width | ± 100 Cycles |
| Radiated Signal | ICW Time Multiplex between Master and Slaves |
| Radiated Power | 10W or 40W |
| Working Range | 50-100 Miles Temperate Lats.<br>25- 50 Miles Tropical Lats. } 10 W Radiated Power |
| | 100-200 Miles Temperate Lats.<br>50-100 Miles Tropical Lats. } 40 W Radiated Power |
| ACCURACY: | |
| Hyperbolic Mode | .015 Lane |
| Range-Range Mode | .015 Lane |
| POWER: | |
| Hi-FIX Master or Slave | 6a @ 24 V.D.C. |
| Shipboard Receiver | 4a @ 24 V.D.C. |

---

# HI-FIX

Hyperbolic or Range-Range Electronic Positioning System for Survey Accurate - Compact - Light Weight - Rugged - Mobile - Narrow Band




Based on the Sound principles and employing the same techniques as the Decca Worldwide Navigation System.

RAYTHEON

# FATHOMETER® DEPTH SOUNDERS

PRODUCT DATA

## Model DE-719

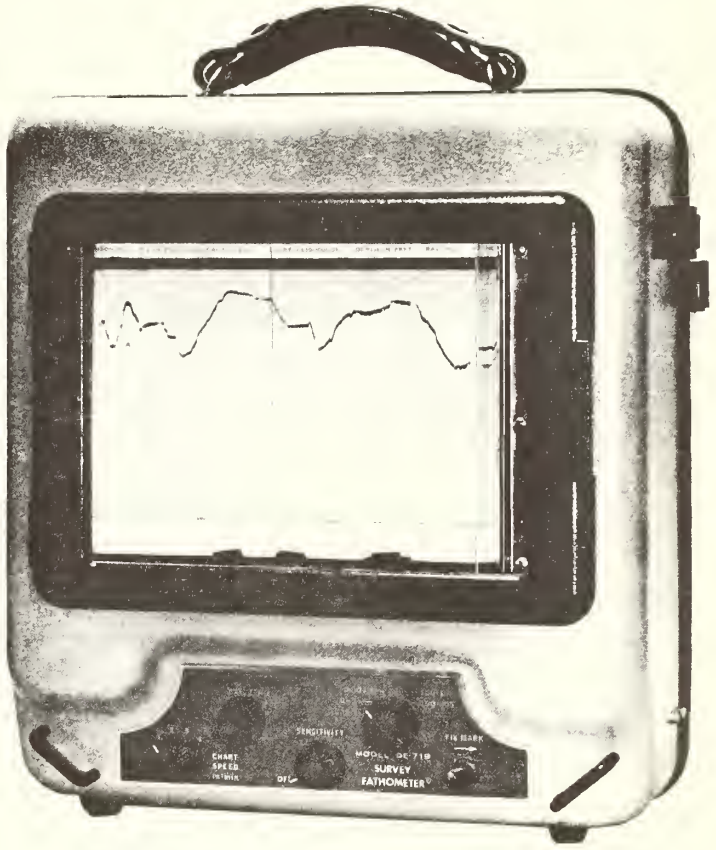


### DESCRIPTION

The Raytheon Model DE-719 Fathometer® Depth Sounder has been designed for use as a portable survey instrument to provide accurate, detailed permanent recordings of underwater topography. Its low power consumption, portability, ease of set-up and rugged construction make it ideal for use on small boats.

The complete system consists of a transducer and recorder. The transducer mount and rigging are stowed in the recorder case when not in use. In operation, the transducer is mounted on the sectional tube supplied and the tube is then secured to the side of the boat. When the battery cable has been connected, the equipment is ready to operate.

The DE-719 is advance design equipment utilizing completely solid state circuitry, magnetic keying and electronically controlled stylus speed. The equipment is housed in a splash-proof aluminum cabinet required for operation in unprotected locations.




*Model DE-719 Fathomer® Depth Sounder*

High resolution chart recordings result from a combination of very narrow transducer beamwidth, high sounding rate, fast stylus speed and fast chart paper speed.

The DE-719's flexibility is increased by a front panel tide and draft adjustment, speed of sound control and four paper speeds. Calibration markers that indicate phase in use, tide/draft and sound speed compensation are permanently recorded on the chart for future reference. Equipment can be adjusted to either foot or metric scale recording with use of chart paper of appropriate scale.

### FEATURES

- Portable, compact, lightweight
- Calibration marker
- Tide and draft adjustment
- Four selectable chart speeds
- Hinged chart window for running chart notations
- Fix Marker switch
- Phase Marker
- Remote fix-mark receptacle
- Foot or metric scale calibration
- Completely solid state
- Available for 12V DC, 115/230V AC operation, 50-60Hz
- Plug-in printed circuits
- Magnetic keying
- Belt driven stylus
- New stylus design – long life, quick replacement
- Chart paper speed adaptable to external control.

## DE-719 SPECIFICATIONS

| | |
|---|---|
| *Depth Range | 0-55, 50-105, 100-155, 150-205 Feet<br>0-16.5, 15-31.5, 30-41.5, 45-61.5 Meters |
| Sounding Rate | 534 Soundings per minute |
| **Voltage Input | 12 Volts DC |
| Current Input | 2.5 Amperes |
| Accuracy | 0.5% ± 1" of indicated depth |
| Operating Frequency | 200kHz |
| Transducer | Barium titanate – model 2445AD |
| Transducer Beamwidth | 8° at the half power points |
| Chart Paper Speed | 1, 2, 3, 4 inches per minute |
| Chart Paper | 7 inches X 60 feet |
| Recorder Dimensions | Height (including handle) – 18"<br>Width 15-3/8"<br>Depth 9-1/16" |
| Net Weight | Recorder w/transducer and rigging 47 lbs.<br>Recorder only – 38 lbs. |

*All of the above basic depth ranges may be multiplied by two by means of the range doubling switch.

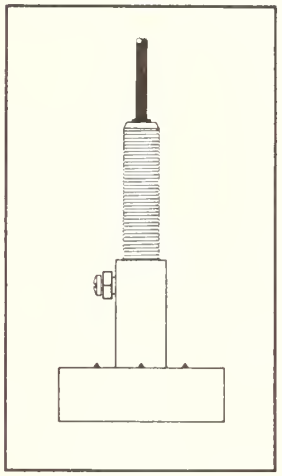
**The system will operate within specifications between 11.5 and 14.8V DC input. On order, the equipment can be furnished with a built-in power converter. The converter will permit operation on 115/230V AC, 50 to 60Hz, in addition to 12V DC.

**Tide and Draft Adjustment:** A minus 5 to plus 30 foot adjustment may be set in by means of a control knob. This varies the position on the chart of the transmitter signal, but allows a sharp fixed reference zero-line to remain at the chart zero calibration line.

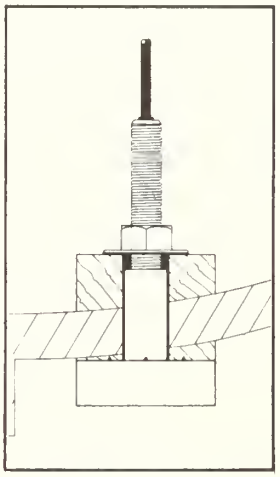
**Sound Speed Compensation:** A control is provided to compensate for water temperature and salinity content. Adjustment of the control permits the recording accuracy to be calibrated to a "check-bar" reading. A calibration marker, that indicates the degree of compensation, is permanently recorded on the chart.

**Fix-Mark:** A front panel switch is provided to inscribe a solid, vertical reference line on the chart. This line is used as an event marker or time reference. A receptacle is included to permit connection of an external fix-mark switch, available as an accessory.

**Transducer:** The DE-719 is supplied with the 2445AD transducer which may be fitted to the six foot section tube for outboard mounting or permanently installed through the hull. In situations where extreme bottom definition is required, the model 7245 narrow beam transducer is recommended.



*2445AD Transducer*



*Thru-hull Mounting*

*7245 Narrow-Beam Transducer*

MARINE PRODUCTS OPERATION
213 EAST GRAND AVENUE • SOUTH SAN FRANCISCO, CALIFORNIA 94080

Raytheon Factory Sales & Service Facilities: Seattle; South San Francisco, Wilmington (Los Angeles); New Orleans; Tampa; Jacksonville; Norfolk; Baltimore; Washington, D.C.; Brooklyn; Allston (Mass.); Cleveland • IN EUROPE: Raytheon Service Co., 6-8, Siljangade, 2300 Copenhagen S, Denmark, Telephone: AM 3311 • OTHER WORLD AREAS: Raytheon Company, International Sales & Services, Lexington, Massachusetts 02173, U.S.A., Telephone: VO 2-6600.

Edo Western CORP.
GENERAL OFFICES: 2645 South 300 West Street, Salt Lake City, Utah 84115 · (801) 486-7481 Telex: 388-315

DR-10C

# MODEL 4034C
# PRECISION SURVEY DEPTH RECORDER

## FEATURES

- Portable
- DC operated
- Solid-state electronics
- Immediate on (no warmup required)
- Range of 0-60 feet up to 600-720 fathoms (Nine selectable scales)
- 0.2% accuracy
- Proven reliability
- Permanent chart recorder
- Operates in adverse environments
- Available in standard or metric versions


The Model 4034C Sonar Sounding System is designed to measure and permanently record water depths and to present a graphic plot of depth versus time on a calibrated paper chart. Portability is the system's most outstanding feature. Its small size allows ease of transportation to any location, as well as use under the most adverse conditions due to the rugged construction of the equipment.

The system operates from 24-28 VDC power source, and the solid state electronics allow immediate use without warmup. This system has proven to be an invaluable tool in helicopter installations for use in "thru-ice" soundings. It is also ideal for use on inland waterways, and in shallow waters such as found on the Continental Shelf, as very high display resolution is obtainable in shallow waters.

The basic Model 4034C system consists of two units—a transmitter/receiver/recorder and a transducer with interconnecting cables. The recording unit opens from the top, and is contained in a cast aluminum alloy cabinet only 10" high, 18½" wide, 14¾" deep, and weighs approximately 50 pounds. The transducer usually selected is Edo Western's Model 4034C-6122 Wide Beam Transducer.

The standard version of this system records depths in feet or fathoms as selected by a mode switch on the front panel. The metric version produces records measured in meters with two different range scales. Specially calibrated chart paper with rectilinear scale lines representing meters for the metric version and feet/fathoms for the standard version is available from Edo Western's standard spare parts stock.

DR-10C

Edo Western

# MODEL 4034C PRECISION SURVEY DEPTH RECORDER

## PERFORMANCE CHARACTERISTICS

### TRANSMITTER/RECEIVER/RECORDER

| | |
|---|---|
| **Range Scales** | |
| Model 4034C (Standard) | 0-60, 50-110, 0-120, 100-220, 200-320, 300-420, 400-520, 500-620, 600-720 feet or fathoms |
| Model 4034CM (Metric) | 0-18, 15-33, 0-36, 30-66, 60-96, 90-126, 120-156, 150-186, 180-206 meters<br>0-180, 150-330, 0-360, 300-660, 600-960, 900-1260 meters |
| **Draft Control** | −5 to +25 feet (continuously variable on front panel) |
| **Pulse Length** | 0.25, 1, 5, 12, 20, or 30 milliseconds (depending on RANGE SCALE setting) |
| **Repetition Rate** | 726, 363, 181, 120, 60, or 30 pulses/minute (depending on RANGE SCALE setting) |
| **Operating Frequency** | 24 kHz |
| **Type Transmission** | Pulsed continuous wave (300 watts) |
| **Type Reception** | Pulsed continuous wave (10 microvolt sensitivity) |
| **Power Requirements** | 24-28 volts dc, 5 amperes, 140 watts |
| **Accuracy** | 0.2% |
| **Sound Velocity** | |
| Standard | Variable — selected by internal thumbwheel switches 4600 to 5300 ft./sec. in 10 foot increments |
| Metric | 1400 to 1599 m/sec. in one meter increments |
| **Chart Paper** | |
| Type | Dry, electrosensitive |
| Length | 100 feet (with end-of-chart indications) |
| Width | 7¼ inches |
| Speeds | 0.1, 0.5, 1.0, 2.0, and |
| **Chart Paper Calibration** | |
| Standard Version | Rectilinear scale — lines representing every 2 feet or fathoms of depth, with emphasis at every 10 feet |
| Metric Version | Rectilinear scale — lines representing every 5 meters or decimeters of depth, with emphasis at every 10 meters |

### MECHANICAL

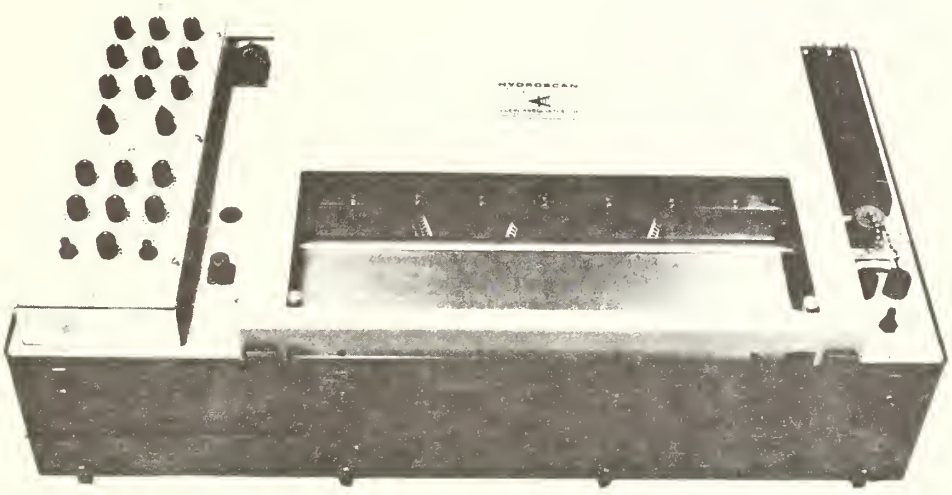
| | |
|---|---|
| **Height** | 10.12 inches (25.7 cm) |
| **Width** | 18.50 inches (47.00 cm) |
| **Depth** | 14.75 inches (37.47 cm) |
| **Weight** | 50 pounds approx. (22.68 kg) |

# KLEIN ASSOCIATES, INC.
# SIDE SCAN SONAR/ SUB-BOTTOM PROFILER

## MODEL 530

The System Model 530 consists of a Model 531 Recorder, Model 532 Towfish, a Tow Cable and various accessories.

## MODEL 531 THREE CHANNEL RECORDER




## FEATURES

- **RELIABLE PRINTING** — Wireless writing helices allow for long term continuous operation with minimal maintenance
- **NO CROSSTALK** — Special construction and electronic techniques, including individually shielded plug-in boards eliminate interference between channels
- **FRONT PANEL CONTROLS** — All controls, including Range, Paper Speed, and all Time-Variable-Gain and Printing Controls are accessible on the front panel. Controls are designed for ease of operation and versitility
- **SPLASHPROOF** — All panels, switches, controls, and connectors have gaskets or seals to keep out moisture and spray
- **REMOTE EVENT/ TWO MINUTE MARK** — Built in event mark remote event mark and two minute marker. A cable is supplied with sealed pushbutton for remote event mark
- **PLUG-IN ELECTRONICS** — System electronics are on plug-in printed circuit boards. Test points and calibration adjustments are easily accessible from the front of the recorder. A built-in extender is included for servicing
- **HANDS-OFF TUNING®** — The Klein Patented Hands Off Tuning with Texture Enhancement is built into the system to greatly facilitate operation and to improve the quality of records

The Model 531 Three Channel Recorder is a true three channel unit in which all channels print simultaneously (It is not a "split trace" single channel recorder in which channels print one by one so the data rate is cut down to 1/3 for each channel). The Model 531 Recorder is primarily designed for two side scan and one sub-bottom profiler channels. It has the versatility of incorporating various sub-bottom profile transducers, or a third channel for another scanning sonar transducer.

# SPECIFICATIONS
## MODEL 531 RECORDER

| | |
|---|---|
| RANGE SCALES | 10 Switchable Scales: 25, 37.5, 50, 75, 100, 150, 200, 300, 400, and 600 meters. Alternative scales optional. |
| PAPER SPEEDS | 20, 30, 40, 50, 60, 70, 80, 90, 100, 110 Lines/Cm and continuously variable. |
| SIZE | Height: 9 inches (22.9 cm)<br>Width: 34¼ inches (87 cm)<br>Depth 18 3/8 inches (46.7 cm) |
| WEIGHT | 100 lbs (45.4 kg) |
| INPUT VOLTAGE | 23-30 Volts D.C. (Input protected from reverse voltage or overvoltage) and 110/220 VAC 47-63Hz |
| D.C. INPUT CURRENT | 2.5 Amperes (3A average) |
| PAPER WIDTH | 19 inches (48 cm.) |
| WRITING WIDTH (Each Channel) | 5 inches (12.7 cm) |
| SCALE LINES | Every 15 meters (Adjustable from 2 to 25 meters) |
| RECORDING COLOR | Sepia or Black |
| PAPER CAPACITY | 200 feet (61 meters), standard roll 100 ft (30.5 meters) |

## MODEL 532
## THREE CHANNEL HYDROSCAN TOWFISH

The Model 532 Towfish contains the sub-bottom profiler transducer and side scan transducers in one streamlined package. Each transducer section contains its own built-in drivers and buffer amplifiers for maximum efficiency and crosstalk reduction. The Towfish contains a standard Klein Side Scan Towfish. Either the Side Scan or Sub Bottom Profiler section may be used individually or as a combined unit.

### SIDE SCAN SONAR SECTION:

| | |
|---|---|
| OUTPUT FREQUENCY | 100 KHz (Others available) |
| OUTPUT PULSE LENGTH | 0.1 Millisecond |
| OUTPUT ACOUSTIC LEVEL | 128 db (peak) ref 1 microbar at one meter |
| VERTICAL BEAMWIDTH | 40 degrees angled down 10 degrees from the horizontal |
| HORIZONTAL BEAMWIDTH | 1 degree (to 3 db points) standard ¼ degree and 1.5 degree also available |
| COVERAGE | Up to 1000 meters (500 meters to either side) |
| DEPTH | 7,500 Ft (2273m) |

### SUB-BOTTOM PROFILING SECTION:

| | |
|---|---|
| OUTPUT FREQUENCY | 3.5 KHz (others optional) |
| OUTPUT PULSE WIDTH | 0.4 milliseconds |
| OUTPUT PULSE LEVEL | 110 db (peak) ref 1 microbar at one meter |
| BEAM ANGLE | 50 degrees, conical, pointed straight down |
| DEPTH | 1000 Ft (300m) others optional |

### OVERALL TOWFISH:

| | |
|---|---|
| SIZE | Length: 60 inches (152.4 cm)<br>Diameter 12 inches (30.5 cm) |
| WEIGHT | 150 Lbs (68.2 Kg) |

### Tow Cable Assemblies

Two types of tow cable assemblies are available... lightweight and armored. The lightweight units are best for small boat operation or shallow operation. The armored units are best for deep or high speed operations. The cables are described as follows:

| TYPE | DIAMETER | BREAKING MEMBER | STRAIN MEMBER | JACKET | PART NO. |
|---|---|---|---|---|---|
| Lightweight | 3/8" | 6000 Lbs. | Kevlar (DuPont) | Polyurethane | 532B-001-xx-M |
| Armored | 1/2" | 15,000 Lbs. | Steel (Galv.) | Steel | 532B-002-xx-M |

To complete part number, put length of cable for xx. Last letter is M for meters or F for feet. Unless otherwise specified, standard systems include a 100 meter lightweight cable, Part Number 532B-001-0100-M.

### Towing Accessories

Standard available accessories include a snatch block which matches the tow cable, a strain member for securing the cables, hand and electric winches with interchangeable reels and optional slip ring, towing shock absorbers, a built-in pinger for location and various depressors for special tow situations.

KLEIN ASSOCIATES, INC.
UNDERSEA SEARCH AND SURVEY
Route 111.RFD 2• Salem, New Hampshire 03079 U.S.A.•(603)893-6131
CABLE: SONAR
TELEX: [illegible]439

EG&G

SPECIFICATION BULLETIN SP-13

# SEISMIC PROFILING SOUND SOURCES

Varied types of Sound Source transducers have been developed by EG&G for a wide range of Seismic Profiling applications. The basic Sound Sources are inter-changeable and modular in design to be used with the standard EG&G Energy Source Components, Hydrophones, and Seismic Recorder.

## UNIBOOM ™

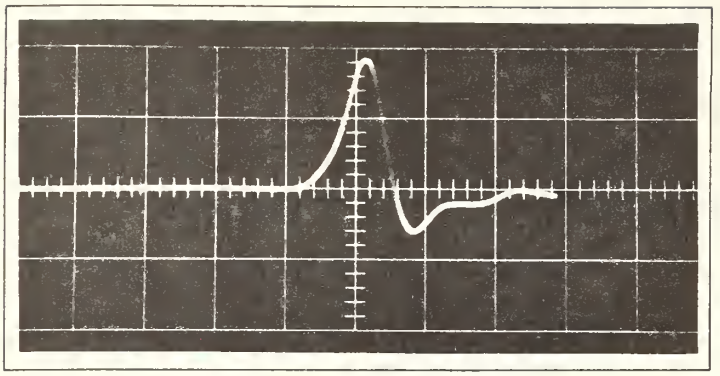
The Model 230 UNIBOOM Unit Pulse Boomer is a *moderate penetration, high resolution* Sound Source transducer utilized for widely varied seismic profiling applications. The electromechanical sound transducer is mounted on a catamaran and is designed to operate with the EG&G capacitance Energy Sources, Seismic Recorder and matching Hydrophone streamer.

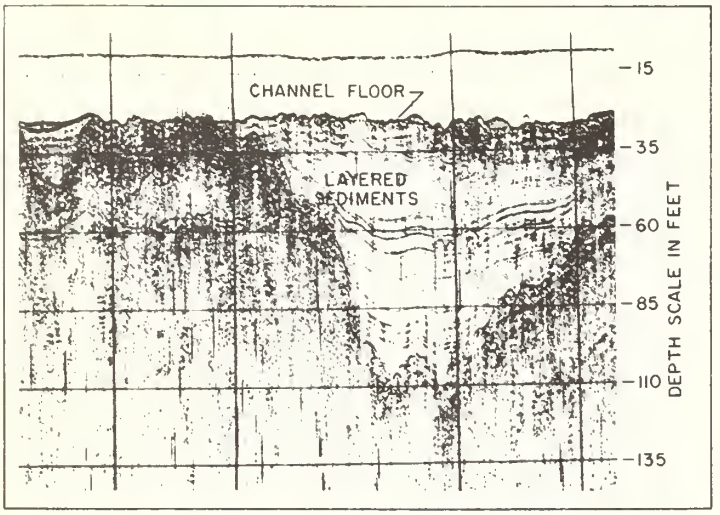
The unique electromechanical assembly consists of an insulated metal plate and rubber diaphragm adjacent to a flat-wound electrical coil. A short duration, high power electrical pulse discharges from the separate Energy Sources into the coil and the resultant magnetic field explosively repels the metal plate. The plate motion in the water generates a single broad band acoustic pressure pulse.

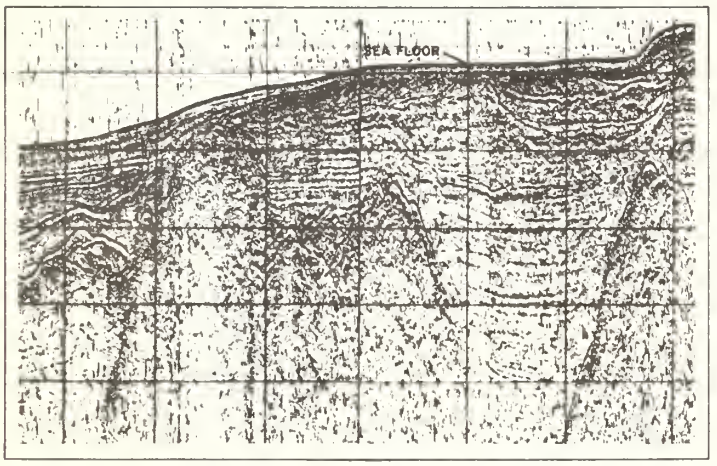
The elimination of the strong cavitation or ringing pulse associated with standard Boomers and Sparkarrays – combined with the broad band frequency spectrum, (1) permits the bottom echo to appear as a fine line; (2) provides a clear cross-sectional record of the sub-bottom interfaces; and (3) penetrates most types of marine materials, including hard-packed sand, up to 75 meters. The UNIBOOM operates equally well in salt water or fresh water.

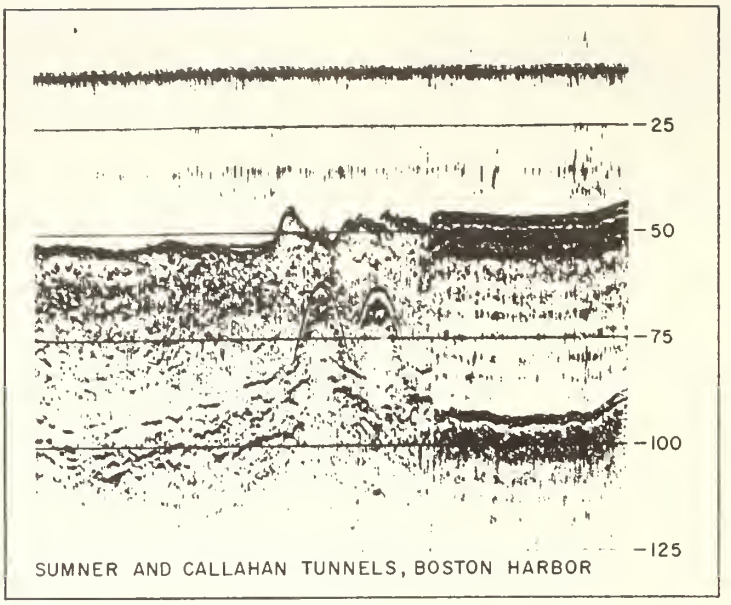
Applications for the Model 230 Unit Pulse Boomer include reconnaissance geological survey, mineral exploration, foundation studies for offshore platforms, harbor development and cable/pipeline crossing surveys.

# UNIBOOM™ (continued)



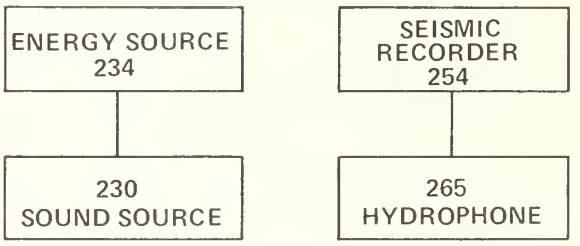


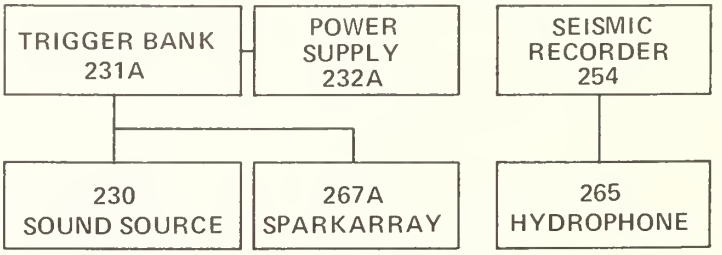



SUMNER AND CALLAHAN TUNNELS, BOSTON HARBOR

## UNIBOOM SYSTEM




## UNIBOOM SYSTEM & 1000 WATT-SECOND SPARKER




# SPECIFICATIONS

| Pulse Character | | | |
|---|---|---|---|
| Energy Level: | @100 watt-seconds | @200 watt-seconds | @300 watt-seconds |
| Duration: | 0.2 milliseconds | 0.2 milliseconds | 0.2 milliseconds |
| Source Level: | 95 db ref. 1 microbar at 1 meter | 104 db ref. 1 microbar at 1 meter | 107 db ref. 1 microbar at 1 meter |
| Spectrum: | 700 Hz to 14 kHz | 500 Hz to 10 kHz | 400 Hz to 8 kHz |
| Repetition Rate: | 6 pulses/second | 4 pulses/second | 2 pulses/second |

| | |
|---|---|
| Dimensions: | 84 cm (W) to 59cm(H) x 158cm (L) (33" x 23" x 62") |
| Weight: | 90 kg (200 lbs.) |
| Cable Length: | 25 meters (80ft.) |
| Towing Speed: | 2 to 8 knots |

# Hydro Products®
## A TETRA TECH COMPANY

# MINIATURE UNDERWATER TELEVISION CAMERA


**TC 125**

## FEATURES

- TRULY ENGINEERED FOR THE ENVIRONMENT BY PEOPLE WITH OVER 15 YEARS' EXPERIENCE IN SUPPLYING UNDERWATER TELEVISION EQUIPMENT
- COMPLETELY SELF-CONTAINED IN A MINIATURE UNDERWATER HOUSING
- DYNAMIC RANGE GREATER THAN 10,000:1
- NUMEROUS OPTIONS TO THE BASIC TC 125 WILL OPTIMIZE IT FOR VIRTUALLY ANY UNDERWATER OR ENVIRONMENTAL APPLICATION
- EASY MAINTENANCE – ONLY THREE PLUG-IN ELECTRONIC CIRCUIT BOARDS
- A SAFE 12 VDC OPERATES THE CAMERA
- REMOTE FOCUS CONTROL
- STANDARD HYDRO PRODUCTS' UNCONDITIONAL 1 YEAR WARRANTY
- INDIVIDUALLY VIBRATION/SHOCK TESTED

## DESIGN

The ultimate in underwater viewing can be obtained with the Hydro Products' TC 125 Television Camera Fifteen years of experience produced this practical tool for the underwater researcher or engineer. As in all Hydro cameras, the self-contained design is optimized to perform underwater viewing tasks from optics to electronic circuitry to pressure housing. Each component has been maximized for the highest reliability and ease of operation.

The Model TC 125 is designed utilizing highly reliable integrated circuits. This miniaturization of the circuits has resulted in an easily maintained camera constructed with only three major plug-in circuit boards.

The TC 125 is totally self-contained including target control, video and sweep circuits, and remote optical focus all powered by a safe, low DC voltage. Nothing complicated, only five conductors control the camera including focus from 3 inches to infinity.

From the surface, the TC 125 is simple to control. Power switch, focus control, and standard monitor controls are all that are required. The system is easier to operate than your home television set giving the operator the maximum performance possible in the harsh underwater environment.

Every feature of this camera has been designed for ease of operator use without sacrificing the special performance and circuitry required to view underwater.

The Hydro Products' Model TC 125 Underwater Television Camera is the most reliable and versitile available in the world today. OVER FIFTEEN YEARS OF HISTORY PROVES IT!

# SPECIFICATIONS

## ELECTRICAL

| | |
|---|---|
| ELECTRICAL CONDUCTORS: | To maximize reliability, camera operates with only Coax, plus one #18 wire. Two additional #18 wires for remote focus. |
| POWER REQUIREMENT: | 600 ma constant current, nominal voltage at camera – 13V. |
| PROTECTION: | Any connection may be electrically connected to any other without damage. |
| SAFETY: | Housing isolated from all connections. A minimum of 10 megohms when measured with a megger at 500 Volts potential. |
| COMPOSITE VIDEO SIGNAL: | Overall signal 1.2 Volts peak to peak. 0.9V video, 0.3V sync. |
| RESOLUTION: | Horizontal 600 TV line minimum. |
| SHADES OF GREY: | 10 in accordance with EIA standard RS-170. |
| VIDEO BAND WIDTH: | DC to 8 megahertz minimum. |
| SCANNING STANDARD: | 525 line double interlaced scanning, U.S. (EIA) standard. (625 line European standard optional). |
| CAMERA SYNC: | Crystal controlled master oscillator and binary frequency decoders providing 15.75 kHz horizontal, 60 Hz vertical sync (optionally 50 Hz). Master oscillator stability ±0.01% over temperature range specified. |
| TARGET CONTROL: | Fully automatic over dynamic light range greater than 10,000:1. |
| LIGHT LEVEL SENSITIVITY: | 1.0 footcandles at vidicon gives full 600 TV lines and 0.1 footcandles gives 400 lines. |
| CAMERA CIRCUITRY: | All solid state components, mounted on 3 plug-in glass epoxy circuit boards. |
| VIDICON: | Type 7262A peaks in green at 5500 Angstroms to maximize underwater viewing. |

## ELECTRICAL CONTROLS:

The following electrical control adjustments are provided within the camera for optimizing vidicon and circuit operation.

| Control | Function |
|---|---|
| Beam | Setting vidicon beam current |
| Target | Optimizing vidicon target operation |
| Vert. Pos. | Adjustment of vertical position of vidicon raster scan. |
| Hor. Pos. | Adjustment of horizontal position of vidicon raster scan. |
| Vert. Size | Adjustment of vertical size of vidicon raster scan. |
| Hor. Size | Adjustment of horizontal size of vidicon raster scan. |
| Elect. Focus | Optimizing electrostatic focus on vidicon. |
| Mag. Focus | Optimizing magnetic focus on vidicon. |
| H V | Sets regulation point on high voltage power supply. |

| | |
|---|---|
| CRITICAL CIRCUIT REGULATION STABILITY: | High voltage regulation – ±0.2%<br>Magnetic focus current regulation – ±0.5% |

## OPTICAL

| | |
|---|---|
| LENS: | 9 element, color corrected, f/1.4, 12.5 mm, standard "C" mount. |

| ANGLE OF VIEW: | In Air | In Water |
|---|---|---|
| Diagonal | 64° | 46° |
| Horizontal | 53° | 38° |
| Vertical | 41° | 30° |

NOTE: With -C option the angle of view in water is the same as in air.

FOCUS RANGE: 3 inches to infinity.

FOCUS CONTROL: ±12 VDC nominal, 5 watts maximum.

## MECHANICAL

| | |
|---|---|
| LENGTH: | 21 inches (53.3 cm) including connector guard. |
| DIAMETER: | 3 inches (7.62 cm). |
| WEIGHT: | 12 lbs. (5.4 Kg) in air, 8 lbs. (3.6 Kg) in water. |
| HOUSING MATERIAL: | 6061-T6 Aluminum, hard anodized with epoxy paint. Stainless Steel and Titanium optional. |
| CONNECTORS: | Bulkhead, XSL-5-BCR, Cable Mate, XSL-5-CCP for external sync (-E option use -6-). |

## ENVIRONMENTAL

| | |
|---|---|
| TEMPERATURE RANGE: | -13° F. to +122° F. (-25° C. to +50° C). |
| OPERATING DEPTH: | Standard, 2,000 feet (610 m)<br>Option -10, 10,000 feet (3,050 m)<br>Option -40, 40,000 feet (12,000 m)<br>All with 50% Safety Factor. |

**Options Available in TC 125:**

**Long Line Amplifier (-A)**

Provides compensation for losses in coaxial cable when lengths exceed 1,500 feet. Up to 5,000 feet RG/59 Coax. By proper cable selection and using special post amplifiers, Hydro Products' cameras can be operated over cable lengths to 20,000 feet without in-line amplifiers.

**Full EIA Broadcast Sync (-B)** (No charge option)

This option provides Full Broadcast Sync in accordance with EIA Standard RS-170. The output of a camera equipped with this option can be used while directly connected to commercial broadcast facilities or after video recording on magnetic tape. With this option, optimum operation can be expected when interfacing with virtually any monitor or video tape recorders.

**External Sync (-E)**

Provides for operation of multiple camera system from single external sync source. If external sync is lost, camera automatically switches to internal sync.

**Helium Atmosphere Certification (-HC)**

The TC-125 can be specially sealed to operate in a helium atmosphere such as SEALAB habitat environment. Helium leak rate certification is less than $10^{-8}$ cc/sec at 1000 psi resulting in operation life greater than 6 months.

**Wide Angle Lens (-W)**

| | |
|---|---|
| Focal Length: | 7.9 mm in water |
| Iris: | f/1.5 |
| Diagonal viewing angle: | 80° (minimum in water) |
| Horizontal: | 66° |
| Vertical: | 52° |

**Zoom Lens (-Z)**

Lens option with remote control of zoom, iris, and focus.

| | |
|---|---|
| Focal length range: | 13 mm to 52 mm |
| Iris: | f/2 to f/22 |
| Focusing range: | 3 feet to infinity |
| Control motors (3): | Zoom, focus and iris |

(Remote Control box included)

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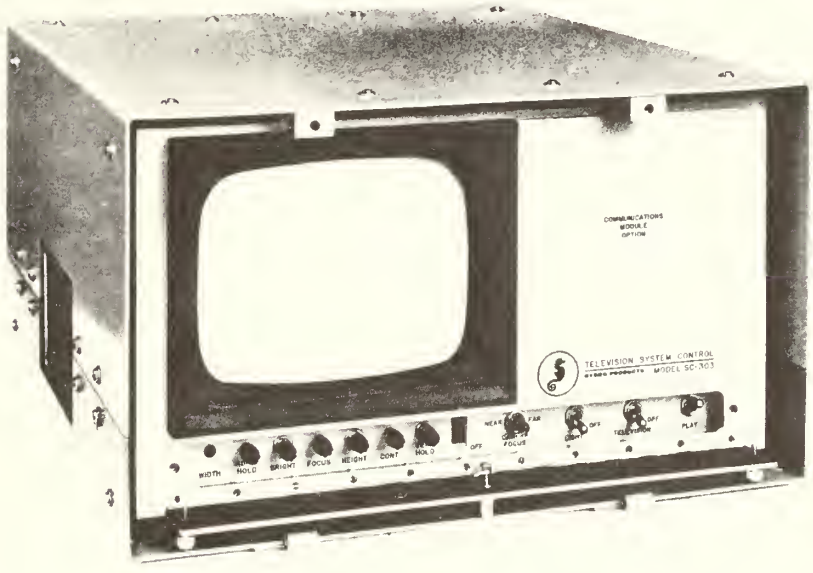
# TV SYSTEM CONTROL UNIT
# MODEL SC 303




## FEATURES

- SPLASH-PROOF CABINET
- RUGGED CONSTRUCTION
- COMPLETE UNDERWATER TELEVISION SYSTEM CONTROL
- PORTABLE

## PERFORMANCE

The Model SC303 Television System Control Unit is engineered for rugged and reliable performance. The unit is ideally suited for shipboard and offshore drilling rig applications. The SC303 contains a transistorized nine-inch monitor of full broadcast quality with a video response of up to 10 MHz, assuring a full 800-line resolution.

Also included in the SC303 is a television camera power supply. It is a constant current power source which will power any of the Hydro Products' underwater TV cameras. This supply also provides power for the camera focus motor. A ballast transformer is included and is designed to provide starting voltage and current control required to operate any of Hydro Products' 250 watt gas discharge lamps. All these items are included in a rugged, splash-proof and portable case. Controls are easily accessible from the front panel, and large, waterproof milti-pin MS type connectors on the rear panel provide ease of system set up. Optional pan and tilt controls, or a diver communication module are also available.

Convenient carrying handles make the unit quite portable, and provisions are made for rack mounting if desired. Construction of the unit insures a splash-proof container, with easy access into the unit when desired. The rugged and compact package of the SC303 simplifies the operation of an underwater TV system and makes the unit a real working tool. The SC303 will work with all of Hydro Products' underwater television cameras and the L7 and L8 light sources.

June 1973

# SPECIFICATIONS

## SC303 TELEVISION SYSTEM CONTROL UNIT

### ELECTRICAL

| | |
|---|---|
| INPUT POWER: | 115 VAC, 60 Hz, 400 watts (nominal); optional 230 VAC, 50 Hz, 200 watts |

### MECHANICAL

| | |
|---|---|
| DIMENSIONS: | 26.0 cm high x 45.7 cm wide x 50.7 cm deep (10.25" x 18.0" x 19.88") |
| WEIGHT: | 31.8 kg (70 lbs.) net; 36 kg (80 lbs.) |

### ENVIRONEMNTAL

| | |
|---|---|
| TEMPERATURE: | -10°C to +55°C |
| HUMIDITY: | 0 to 95% |

### RECOMMENDED ACCESSORIES

| | |
|---|---|
| LIGHTS: | Models L7 or L8 mercury vapor or thallium iodide lights |
| UNDERWATER TELEVISION CAMERAS: | Models TC100, TC110, TC125, TC150 or TC303 |

## SUBASSEMBLY SPECIFICATIONS

### ELECTRICAL

### MONITOR

| | |
|---|---|
| INPUT POWER: | 65 W at 120/240 V, 60Hz (525/60 U.S.) or 50 Hz (625/50 CCIR); all performance specifications will be met while the line voltage varies from 105 to 130 VAC at any rate |
| VIDEO SIGNAL: | 0.3 volt p-p (minimum for 50 volts at kinescope); sync negative at monitor input |
| VIDEO INPUT: | High impedance bridging (equivalent to 50 ohms in parallel with 15pF) can be terminated by an internal 75 ohm load (±1%) through a switch located on rear apron |
| VIDEO RESPONSE: | 10 MHz ± 1 db; differential gain below 5% with 75 V kinescope drive |
| DC RESTORATION: | 100% or zero, sync tip clamp |
| LINEARITY: | Within 2% of picture height |

### MECHANICAL

| | |
|---|---|
| DIMENSIONS: | 21.6 cm wide x 21 cm high x 37.5 cm deep (8.5 x 8.2 x 14.75 in.) |
| WEIGHT: | 8.4 kg (18 lbs.) |

## CAMERA POWER SUPPLY

### ELECTRICAL

| | |
|---|---|
| CIRCUIT DESCRIPTION: | Step-down transformer, full wave bridge rectifier, RC filter, constant voltage regulator, followed by constant current regulator |
| POWER REQUIREMENTS: | 115/230 VAC, 50/60 Hz, 25 W maximum |
| OUTPUTS: | Constant Current: Adjustable over minimum range of 200 to 800 mA (into 25 ohm load)<br>Open Circuit Output Voltage: 28 ± V (with 25 ohm load)<br>Focus Power: ± V unregulated, 5 W maximum for remote control of camera focus |

### MECHANICAL

| | |
|---|---|
| CONTROLS: | On/off power control switch )on front panel SC303); near/far focus control; current level control; current level meter (0-1 amp scale); fuse ½ ampere with spare |
| DIMENSIONS: | 7.8 cm high x 17.9 cm wide x 10.7 cm deep (3.1 x 7.1 x 4.2 in.) |
| WEIGHT: | Approximately 1.4 kg (3 lbs.) |

## LIGHT BALLAST UNIT

### ELECTRICAL

| | |
|---|---|
| INPUT POWER: | 115 VAC, 60 Hz, 300 watts (nominal), 230 VAC, 50 Hz available |
| OUTPUT POWER: | Starting Voltage – 280 VAC<br>Operating Voltage – 135 VAC<br>Operating Current – 2.5 amperes |

### MECANICAL

| | |
|---|---|
| DIMENSIONS: | 13 cm wide x 13 cm high x 23.5 cm deep (5.1 x 5.1 x 9.25 in.) |
| WEIGHT: | 10.4 kg (23 lbs.) |

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# Hydro Products
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# UNDERWATER LIGHTS
# MODEL L7 SERIES

## FEATURES

- INTERCHANGEABILITY OF INCANDESCENT, MERCURY VAPOR AND THALLIUM IODIDE LAMPS
- RUGGEDLY BUILT WITH DEPTH CAPABILITY TO 4,570 METERS (15,000 FEET)
- PARABOLIC REFLECTOR GIVES TRUE FLOOD OF LIGHT – NO HOT SPOTS
- 10,000 OPERATING HOURS OF TESTING INSURE RELIABILITY

## DESIGN

Hydro Products' Model L7 Series Underwater Lights are the result of extensive engineering and an environmental test program never before conducted on any underwater light. Tests included thousands of pressure/temperature cycles and life tests with documentation on over 10,000 operating hours.

The first production units of the L7 Series were delivered for use on the U.S. Navy's DSRV program, and the rigorous testing was required to meet stringent specifications.

The light configuration is extremely compact. Weighing 1.8 kg (4 lbs.), it is 25.4 cm (10 in.) long and 15 cm (5.9 in.) wide at the reflector face. It produces a beam pattern which is a uniform flood, approximately 90° square with no hot spots.

## PERFORMANCE

The L7 Series has been designed so that the same housing can be used with many different light elements. The light bulb is easily replaceable simply by unplugging, allowing the same housing and reflector to be used as a quartz iodide (500 watts), mercury vapor (250 watts), or thallium iodide (350 watts) light. The basic housing and lamp configurations have been designed to operate to depths of 4,570 m (15,000 ft.).

The lamp elements are the latest in design with plug-in electrical connectors and a flat O-ring pressure seal. This design enhances the ease of replacement and protects all electrical connecting surfaces from corrosion and damage. The thallium iodide lamp is the most advanced, providing over four times the light energy in sea water as an incandescent lamp of equivalent wattage. The mercury vapor lamp provides light energy at a level twice that of the incandescent lamp, and will continue efficient operation for 5,000 hours. For color photography, the quartz iodide incandescent lamp provides the best color balance.

# SPECIFICATIONS

## MODEL L7 UNDERWATER LIGHT

### ELECTRICAL

| | |
|---|---|
| INPUT POWER REQUIREMENTS: | 115 VAC, 60 cps, 300 watt nominal, normally supplied from standard 250 watt mercury vapor ballast transformer |
| LAMP OPERATING POWER: | 250 watts nominal when used with Hydro Products' Model LB250 ballast transformer |

### OPTICAL

| | |
|---|---|
| LIGHT OUTPUT: | 2,800 minimum centerbeam candelapower |
| REFLECTOR CHARACTERISTICS: | Field of illumination includes 90° x 90° solid angle with no hot spots. The horizontal beam width is ±45° to 1/2 intensity and the vertical beam width is ±45° to 1/2 intensity |

### MECHANICAL

| | |
|---|---|
| DIMENSIONS: | 25.4 cm (10 in.) long, including connector x 15.7 cm (6.2 in.) wide at reflector face |
| WEIGHT: | Aluminum unit: 1.8 kg (4 lbs.) in air; 1.4 kg (3 lbs.) in water<br>Stainless Steel unit:<br>4.1 kg (9 lbs.) in air; 3.2 kg (7 lbs.) in water |
| HOUSING MATERIAL: | Hard anodized aluminum is standard; #316 stainless steel is available (specify by adding -S to model number) |

### PERFORMANCE

| | |
|---|---|
| MAXIMUM OPERATING DEPTH: | 4,750 m (15,000 feet) |
| WARM-UP TIME: | 12 minutes maximum |
| AVERAGE LIFE: | 5,000 hours |
| REPLACEMENT BULB TYPE: | Model MV7 250 watt |

## MODEL LT7 UNDERWATER LIGHT

### ELECTRICAL

| | |
|---|---|
| INPUT POWER REQUIREMENTS: | 115 VAC, 60 cps, 300 watt nominal, normally supplied from standard 250 watt mercury vapor ballast transformer |
| LAMP OPERATING POWER: | 250 watts nominal when used with Hydro Products' Model LB250 ballast transformer |

### OPTICAL

| | |
|---|---|
| LIGHT OUTPUT: | 4,000 minimum centerbeam candelapower |
| REFLECTOR CHARACTERISTICS: | Field of illumination includes 90° x 90° solid angle with no hot spots. The horizontal beam width is ±45° to 1/2 intensity and the vertical beam width is ±45° to 1/2 intensity |

### MECHANICAL

| | |
|---|---|
| DIMENSIONS: | 25.4 cm (10 in.) long, including connector x 15.7 cm (6.2 in.) wide at reflector face |
| WEIGHT: | Aluminum unit: 1.8 kg (4 lbs.) in air; 1.4 kg (3 lbs.) in water<br>Stainless Steel unit: 4.1 kg (9 lbs.) in air; 3.2 kg (7 lbs.) in water |
| HOUSING MATERIAL: | Hard anodized aluminum is standard; #316 stainless steel is available (specify by adding -S to model number |

### PERFORMANCE

| | |
|---|---|
| MAXIMUM OPERATING DEPTH: | 4,750 m (15,000 feet) |
| WARM-UP TIME: | 12 minutes maximum |
| AVERAGE LIFE: | 500 hours minimum |
| REPLACEMENT BULB TYPE: | Model TI7 250 watt |

## LQ7 UNDERWATER LIGHT

### ELECTRICAL

| | |
|---|---|
| INPUT POWER REQUIREMENTS: | 115 VAC/DC, 500 watts (higher voltage may be required to compensate for line losses |
| LAMP OPERATING POWER: | 120 VAC/DC, 250 or 500 watts nominal |

### OPTICAL

| | |
|---|---|
| LIGHT OUTPUT: | 2,000 minimum centerbeam candelapower |
| REFLECTOR CHARACTERISTICS: | Field of illumination includes 90° x 90° solid angle with no hot spots. The horizontal beam width is ±45° to 1/2 intensity and the vertical beam width is ±45° to 1/2 intensity |

### MECHANICAL

| | |
|---|---|
| DIMENSIONS: | 24.5 cm (10 in.) long including connector x 15 cm (6.2 in.) wide at reflector face |
| WEIGHT: | Aluminum unit: 1.8 kg (4 lbs.) in air; 1.4 kg (3 lbs.) in water<br>Stainless Steel Unit: 4.1 kg (9 lbs.) in air; 3.2 kg (7 lbs.) in water |
| HOUSING MATERIAL: | Hard anodized aluminum is standard; #316 stainless steel is available (specify by adding -S to model number) |

### PERFORMANCE

| | |
|---|---|
| MAXIMUM OPERATING DEPTH: | 4,750 m (15,000 feet) |
| WARM-UP TIME: | Less than 1 second |
| AVERAGE LIFE: | 1,000 hours |
| REPLACEMENT BULB TYPE: | Model QI7 watt |

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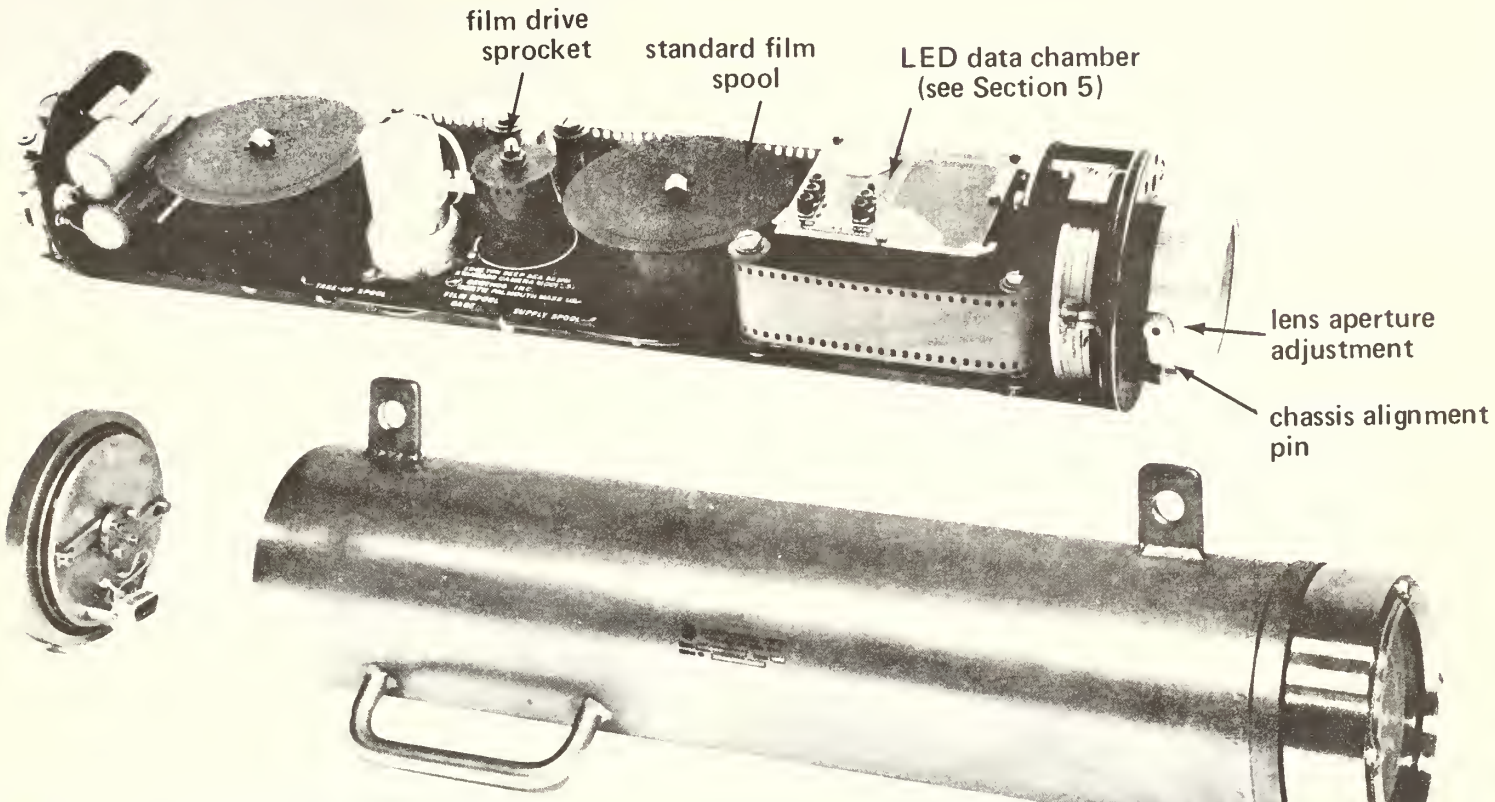
# 3 EDGERTON DEEP SEA 35 MM Stan




## MODEL 372 DEEP SEA STANDARD CAMERA

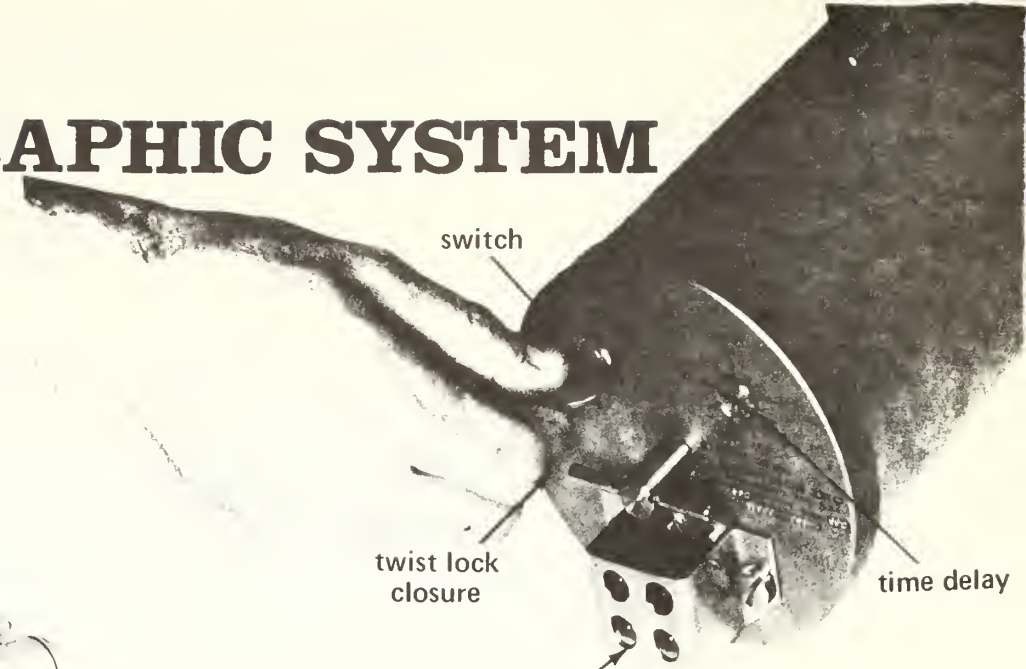
The Benthos Model 372 Edgerton Deep Sea Standard Camera is a general purpose instrument proven for use in a variety of deep ocean applications. The camera takes 800 or more exposures per loading. A data chamber with a light emitting diode digital display, furnishing date, time (hours, minutes, seconds) and run number information on each photo frame, is available as an option.

When used with a Benthos Model 382 Edgerton Deep Sea Standard Flash, the camera becomes a pre-programmed, automatic system. The camera can also be used with the Benthos Model 383 Hi-Intensity Flash (see Section 4) and companion power packs for applications where greater camera-to-subject distances require more light. Stereo photographs can be obtained by spacing two Model 372's with their axes parallel. Precision orientation of the camera chassis in its housing maintains proper alignment for stereo photography.

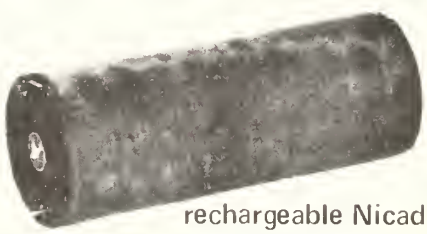
### Specifications — Model 372 Camera

| | |
|---|---|
| Number of exposures per loading using standard film | 800 |
| Number of exposures per loading using thin base film | 1600 |
| Film length using standard film: | 30.5 meters (100 feet) min. |
| Film length using thin base film: | 61 meters (200 feet) min. |
| Spool type: | Standard Kodak No. 10 |
| Spool diameter: | 9.3 cm (3.6 inches) |
| Dimensions: | |
| Length: | 64.3 cm (24.4 inches) |
| Diameter: | 12.5 cm (4.9 inches) |
| Weight in air: | 21 kg (46 pounds) |
| Weight in water: | 16 kg (35 pounds) |
| Shutter speed: | Controllable from 1/50th to 2/5th second from Model 382 Flash or external programmer |
| Power required: | 28 ±5 VDC at 1 amp peak, supplied from external source or Model 382 Flash |
| Data chambers available: | Optical, digital or remote (see Section 5) |

# dard PHOTOGRAPHIC SYSTEM




## up to 1600 exposures per loading



programmer end cap

rechargeable Nicad battery pack

flash tube

chassis assembly

### MODEL 382 DEEP SEA STANDARD FLASH

The self-contained, 100-watt-second Flash is designed as a companion unit to the Model 372 Camera or for use with other Benthos cameras. It contains a solid state electronic camera programmer that puts out electrical impulses at preset intervals causing the camera to take pictures and advance its film. Adjustment of the interval between exposures and for the shutter speed are provided on the internal printed circuit board. The flash also features an externally adjustable electronic timer to delay the start of picture taking while the camera system is being lowered to the desired depth. A switch control on the outside of the rear end cap can be turned to three positions to start the delay, restart the delay or to turn the system on immediately for test. The flash contains a rechargeable nickel-cadmium battery pack which supplies power for both the flash and camera.

*Intervals to 32 hours are available using the Benthos 380-30 low power programmer option. Contact Benthos for application details.

### Specifications — Model 382 Flash

| | |
|---|---|
| Power source: | Benthos Model 389 Battery Pack mounted in Flash housing. 28 VDC Nicad rechargeable type rated at 4 ampere-hours |
| Flash tube input energy: | 100 watt-seconds |
| Number of flashes: | Over 3200 with charged battery |
| Flash duration: | Approximately 1 ms |
| Dimensions: | |
| Overall length: | 90.5 cm (35.6 inches) |
| Housing diam. | 21 cm (8.2 inches) |
| Weight in air: | 31 kg (69 pounds) |
| Weight in water: | 23 kg (50 pounds) |
| Turn-on delay setting: | 0 to 200 minutes |
| Camera exposure duration adjustment: | 40 to 400 ms |
| Exposure interval adjustment: | 3 sec to 2 minutes between* photos or manual |

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# APPENDIX B

# APPENDIX B

# ILLUSTRATIONS: SEA FLOOR MAPPING CATEGORIES

## B.1 INTRODUCTION

A map of the sea floor sediment characteristics was prepared for each of the 10 areas as an aid to delineating marine habitat areas. The sea floor sediment characteristics maps are based on interpretation of the side scan sonar records, sub-bottom profile records, and a comparison of the characteristic reflections from these geophysical records with the videotapes and underwater photographs from the ground truth survey.

For the purpose of mapping, the sea floor sediment characteristics are divided into the following 6 categories which are defined in Section 6.5:

- Pinnacles
- Hard Bottom
- Scattered Hard Bottom
- Coarse Bottom
- Bedforms
- Soft Bottom

In this appendix, 3 illustrations are presented for each of the mapping categories. The illustrations include a UNIBOOM record, a side scan sonar record, and a color transparency from the underwater camera survey. With the exception of the illustrations of the Bedforms, the geophysical records were selected from a site as close as possible to the location where the underwater photograph was taken. The illustrations were chosen both to illustrate the sea floor features and to indicate the interrelationship between the 3 sets of data. In general, more than one data record is required in the mapping process.

It is emphasized that there was limited ground truth data to support the interpretation of the geophysical records. The maps of the sea floor sediment characteristics are largely qualitative and different interpreters may choose to present these data differently. In general, the distinction between categories and the boundaries between the mapped areas are gradational.

## B.2 INTERPRETATION NOTES

A brief description of the records is presented preceeding each set of 3 illustrations. The following data applies to all of the illustrations.

### B.2.1 UNIBOOM Records

- The illustration is a 1:1 scale reproduction of a portion of a record.

- The vertical lines represent shot points (navigation fix locations) which are shown on the Navigation Post Plot Maps. The horizontal

distance between shot points is approximately 150 m.

- The vertical scale of the records is 100 ms (200 ms, Figure B-16 only). The horizontal timing lines are 10 ms apart.

- The vertical exaggeration is approximately 10:1. One millisecond represents a vertical distance of 0.762 m at a velocity of sound of 1524 $m \cdot sec^{-1}$.

- The first major reflection on the records is the water bottom. The entire water column is usually not shown.

B.2.2 Side Scan Sonar Records

- The illustration is a 1:1 scale reproduction of a portion of a record.

- The vertical lines represent shot points which are approximately 150 m apart. Objects will not necessarily apear at the same shot point on side scan and UNIBOOM records because the 2 transducers were towed different distances behind the ship and thus were at different locations when the navigation fix was taken.

- The full scale range setting for all side scan records was 100 m. A full scale record represents 100 m for both the port and starboard transducers. The illustrations show approximately 80% of a full scale record and are not necessarily centered.

- The horizontal timing lines represent an approximate slant range distance between the tow fish and the target of 15 m.

- The first major reflection represents the water bottom. Generally the transducer was towed 10-20 m above the bottom. On some records from shallow water areas a weaker water surface reflection may also be seen.

B.2.3 Underwater Photographs

- Code numbers on the photographs represent the map area and the time of photograph.

- On some photographs a portion of the underwater television sled appears in the lower left corner.

- The illustrations represent colored xerox reproductions of slides. The colors may vary somewhat from the original negatives.

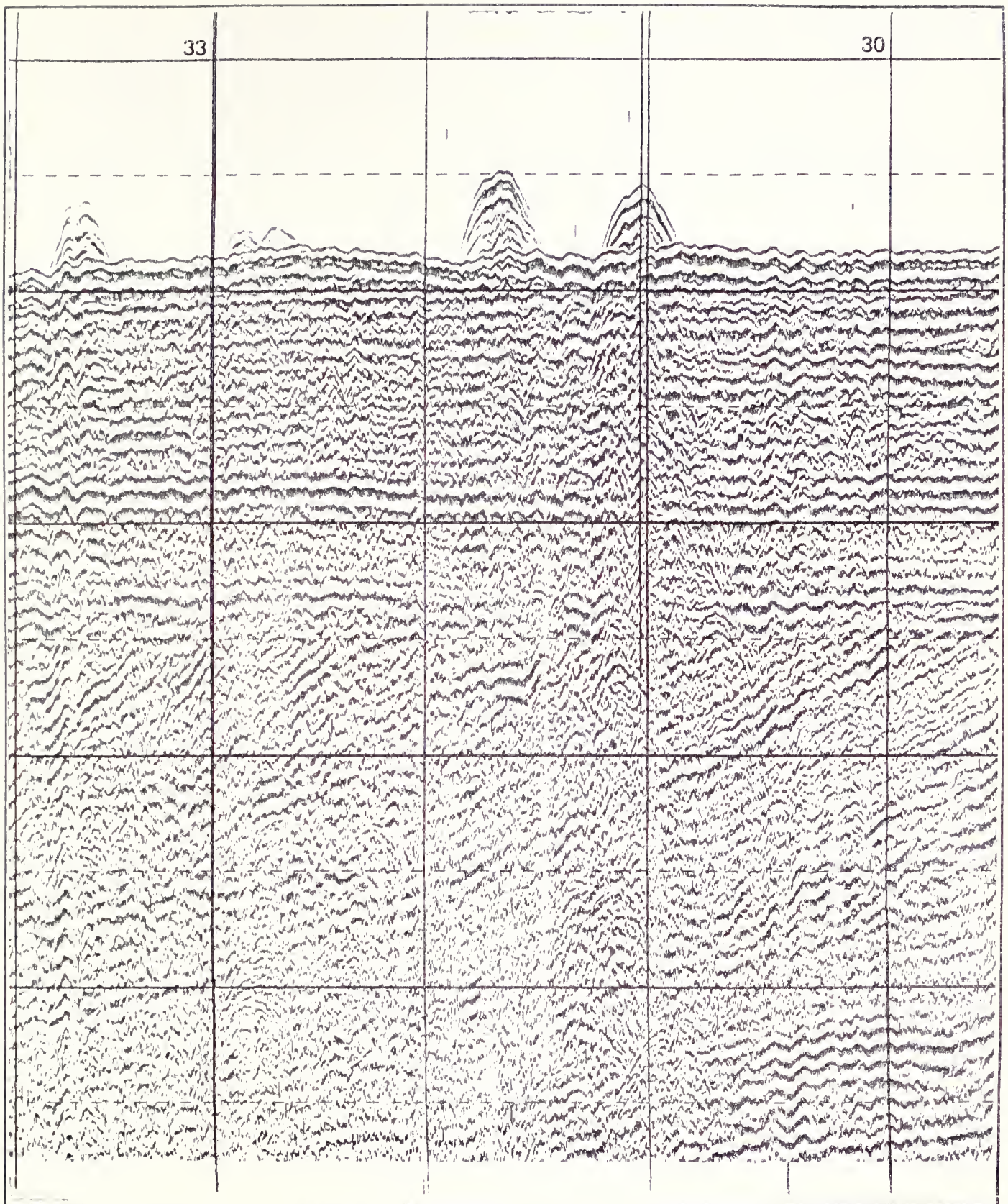
## B.3 PINNACLES

Figures B-1, B-2, B-3
Area 3, Line 107, Shot Points 30-35

Coral reefs or bedrock outcrops that extend 2 m or more above the sea floor are mapped as pinnacles. The aerial extent of the pinnacles may range from <5 m - >100 m. Generally they cannot be mapped as individual features at a scale of 1:48,000. Extensive pinnacle areas were mapped only in Areas 3 and 4 on the flanks of De Soto Canyon.

The 4 pinnacles shown on the UNIBOOM record, Figure B-1, extend 1-6 m (2-8 ms) above the sea floor. The width of the pinnacles, at the base, is 30-45 m; their longitudinal extent cannot be determined from this record. Figure B-2 is the side scan sonar record from the same area. Shot point 30 on the sonar record represents approximately the same location as shot point 31 on the UNIBOOM record. The side scan shows numerous pinnacles which were either too small or too far off to the side to be seen on the UNIBOOM record.

Figure B-3 is a close-up of the vertical face of one of the pinnacles and shows some of the attached organisms. The picture was taken immediately before the sled contacted the outcrop. Videotape records indicated that the top surfaces of many of the pinnacles were covered with a thin layer of fine grained sediment. This sediment layer appeared to limit the development of extensive epifaunal communities.

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| Project: EASTERN GULF OF MEXICO<br>Project No. 41069 | UNIBOOM RECORD AREA 3, LINE 107 | Fig.<br>B-1 |

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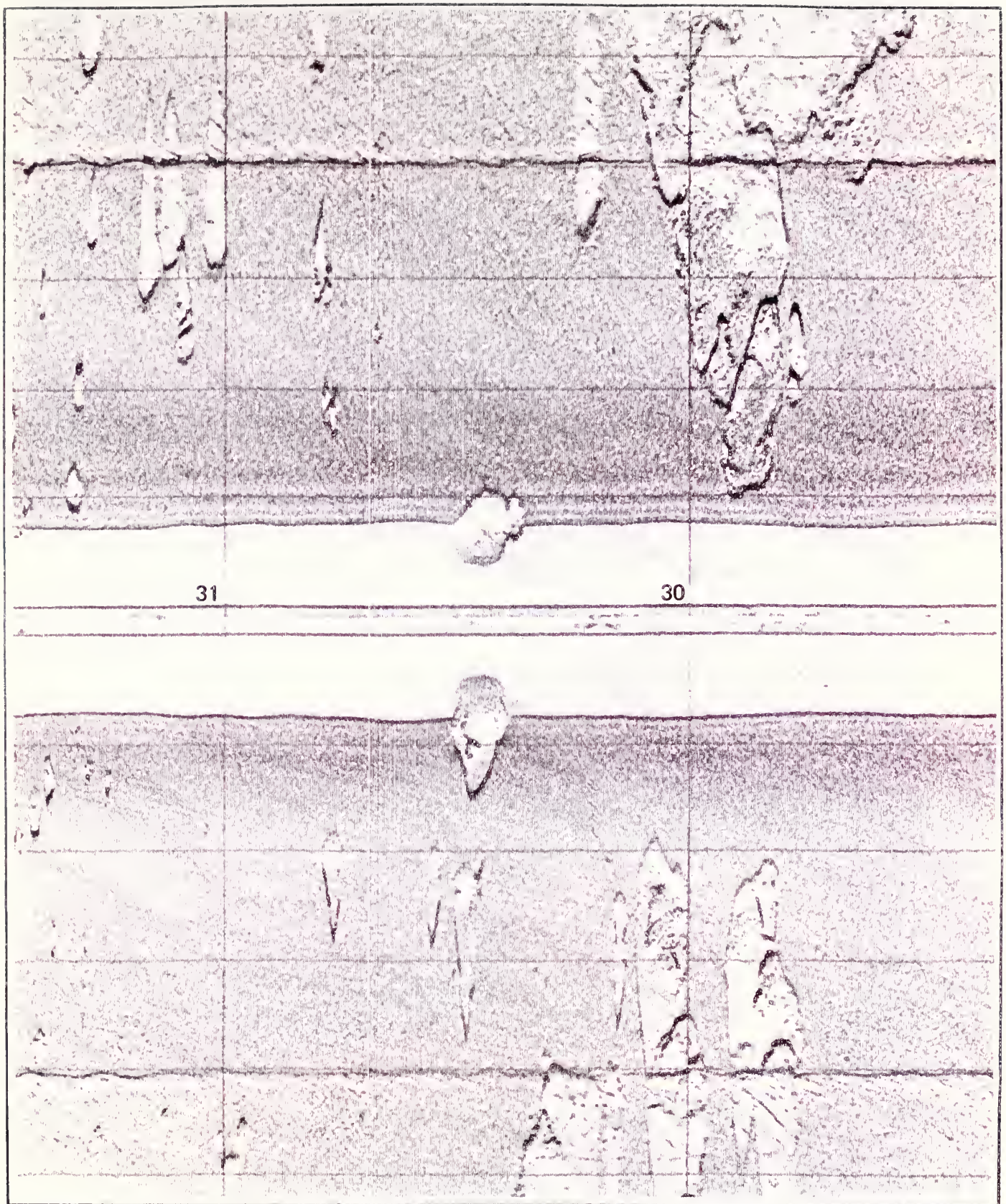


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| Project: EASTERN GULF OF MEXICO<br>Project No. 41069 | SIDE SCAN SONAR RECORD AREA 3, LINE 107 | Fig.<br>B-2 |

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| Project: EASTERN GULF OF MEXICO<br>Project No. 41069 | PINNACLE FACE AREA 3, LINE 107, SP 34 | Fig.<br>B-3 |

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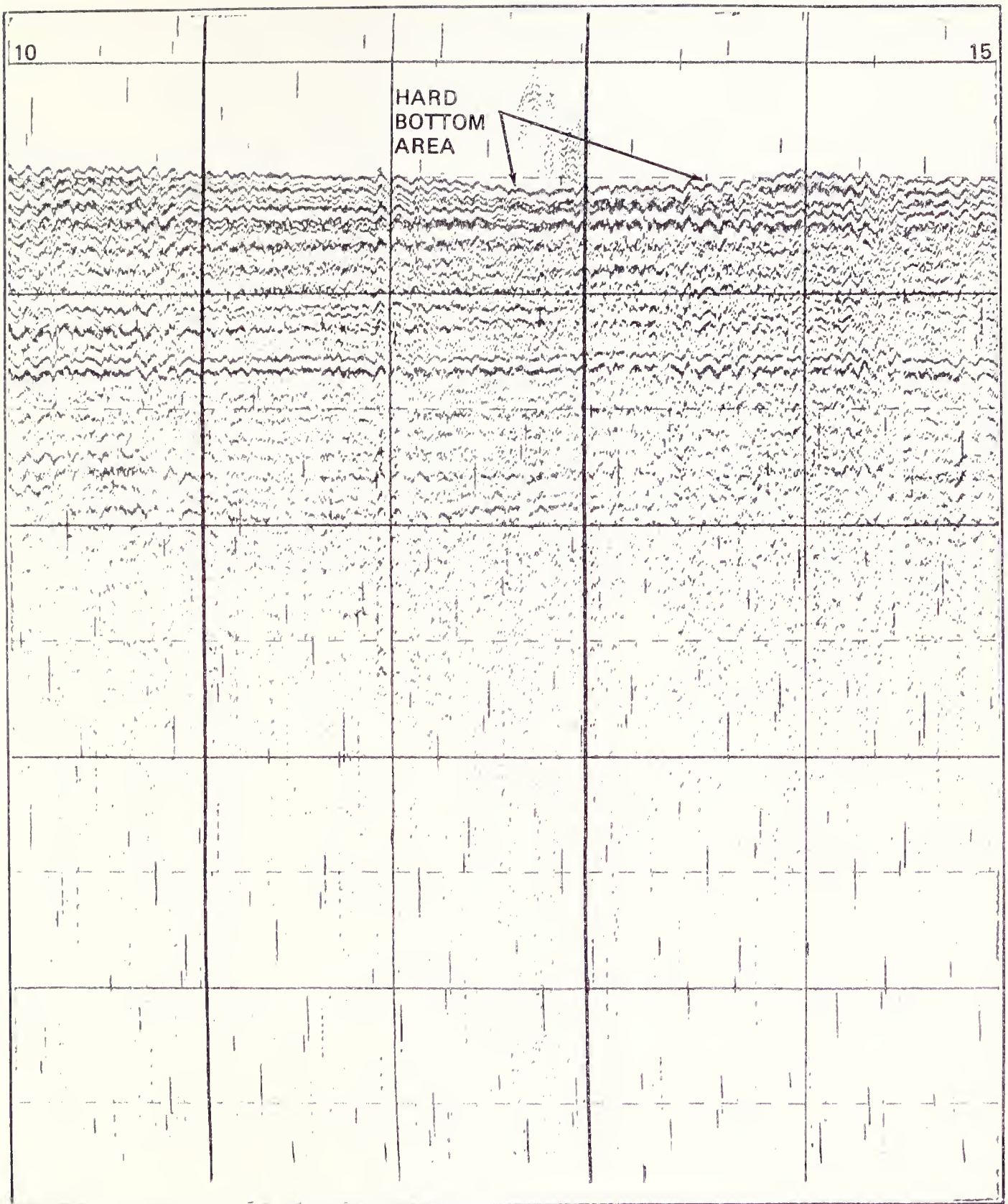
## B.4 HARD BOTTOM

Figures B-4, B-5, B-6
Area 7, Line 205, Shot Points 12-14

Hard bottom has been mapped where there are extensive areas of exposed limestone bedrock or reefs of relatively low relief, generally <2 m. The horizontal extent of the individual outcrops is generally on the order of a few metres which precludes their being mapped as individual features. A thin layer of sand or silt may be present throughout the area. The thickness and extent of the sediment cover was the primary determining factor in classifying hard bottom, scattered hard bottom and soft bottom conditions.

In the illustrations, the hard bottom area occurs in the bathymetric low and on its flanks. The higher areas represent a thin, <1 m, sediment cover on the bedrock. The UNIBOOM record, although indicative of a hard near surface layer, is not definitive. The side scan sonar record indicates the extent of the exposed bedrock and is the primary rason for the hard bottom classification. Faint signal returns in the water column above the outcrop zone may be due to the presence of fish.

The underwater photograph confirms the nature of the bottom as an outcrop area with a thin patchy sediment cover. The limited aerial extent covered by a single photograph or series of photographs limits the underwater camera as a primary mapping tool.

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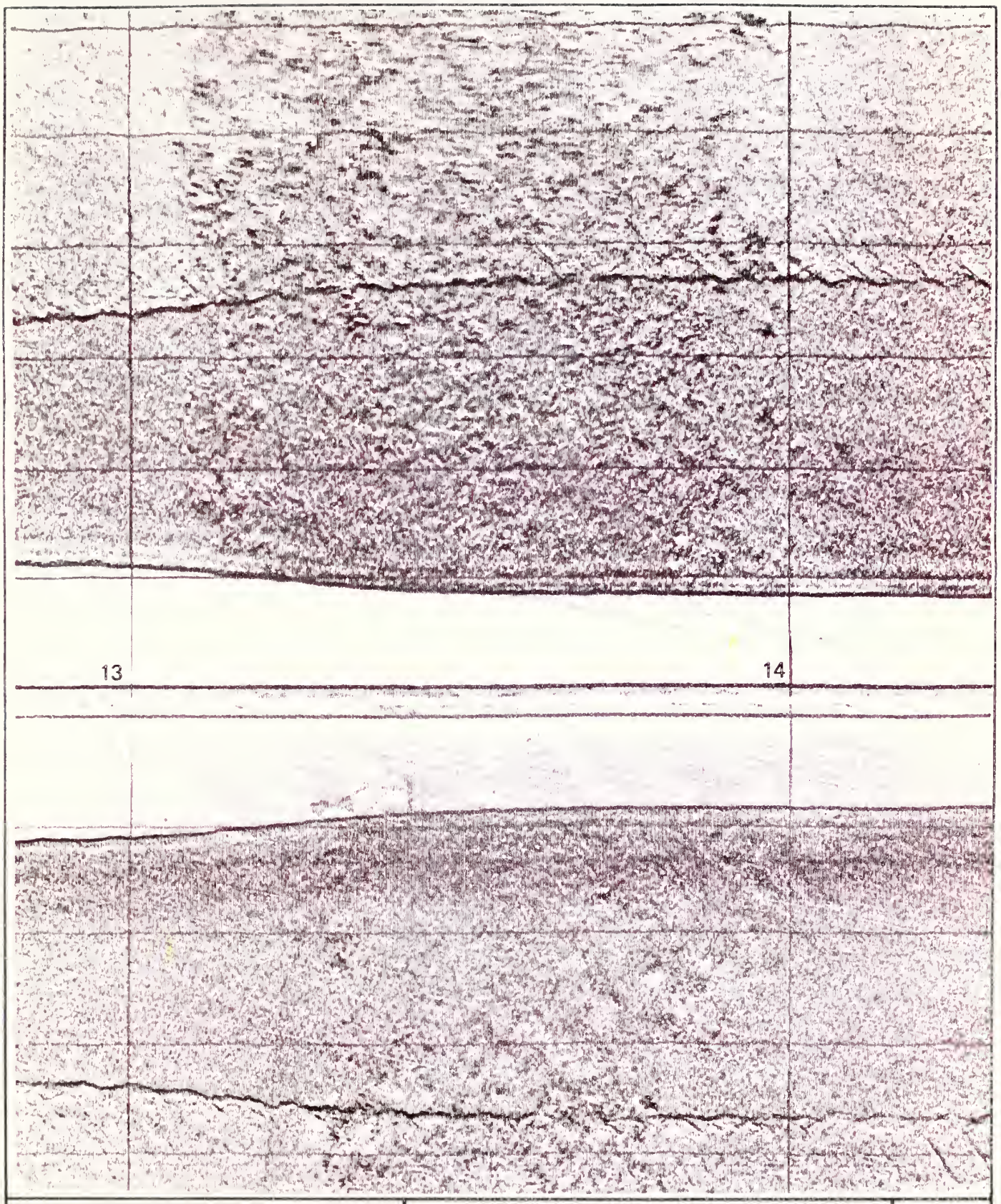
| Project: EASTERN GULF OF MEXICO<br>Project No. 41069 | UNIBOOM RECORD AREA 7, LINE 205 | Fig.<br>B-4 |

WOODWARD-CLYDE CONSULTANTS

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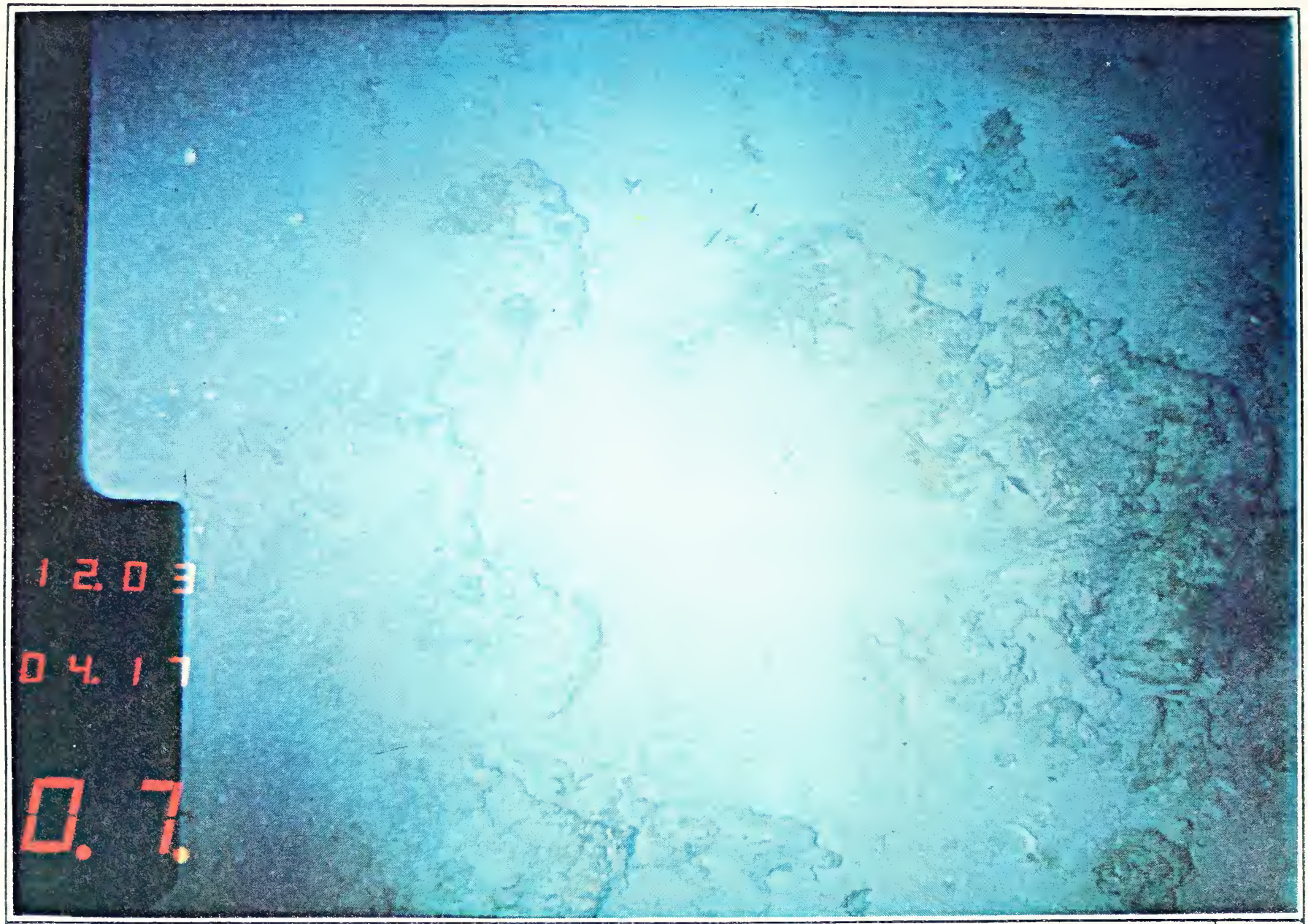
| Project: EASTERN GULF OF MEXICO<br>Project No. 41069 | SIDE SCAN SONAR RECORD<br>AREA 7, LINE 205 | Fig.<br>B-5 |

WOODWARD-CLYDE CONSULTANTS

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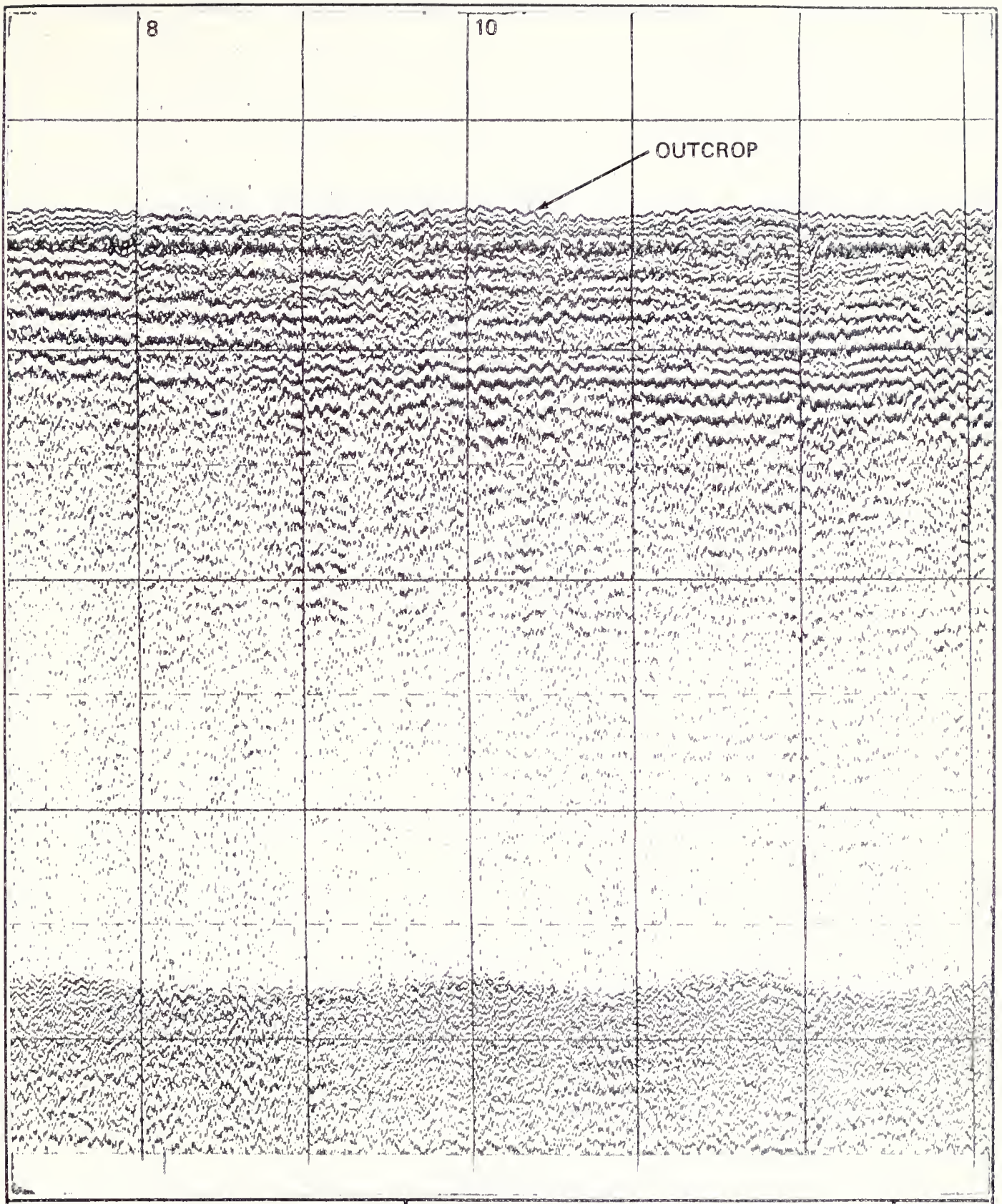
| Project: EASTERN GULF OF MEXICO<br>Project No. 41069 | HARD BOTTOM AREA 7, LINE 205, SP 14 | Fig. B-6 |

## B.5 SCATTERED HARD BOTTOM

Figures B-7, B-8, B-9
Area 9, Line 201, Shot Points 8-12

Scattered hard bottom was mapped in areas of local outcrops of buried reefs or bedrock interspersed with extensive areas of sediment cover. The sediment cover varies from <1 m to up to 3 m. The distinction between hard bottom and scattered hard bottom is qualitative and is based primarily on the relative density of the exposed outcrops.

The illustrations show a typical outcrop ledge from Area 9. The apparent relief on all records is <1 m. Outcrops of 1 m relief or less will not necessarily be identified on either of the geophysical records and may occur in areas mapped as soft bottom. This classification is primarily dependent on the relative density of the outcrops noted on the side scan or the videotape records.

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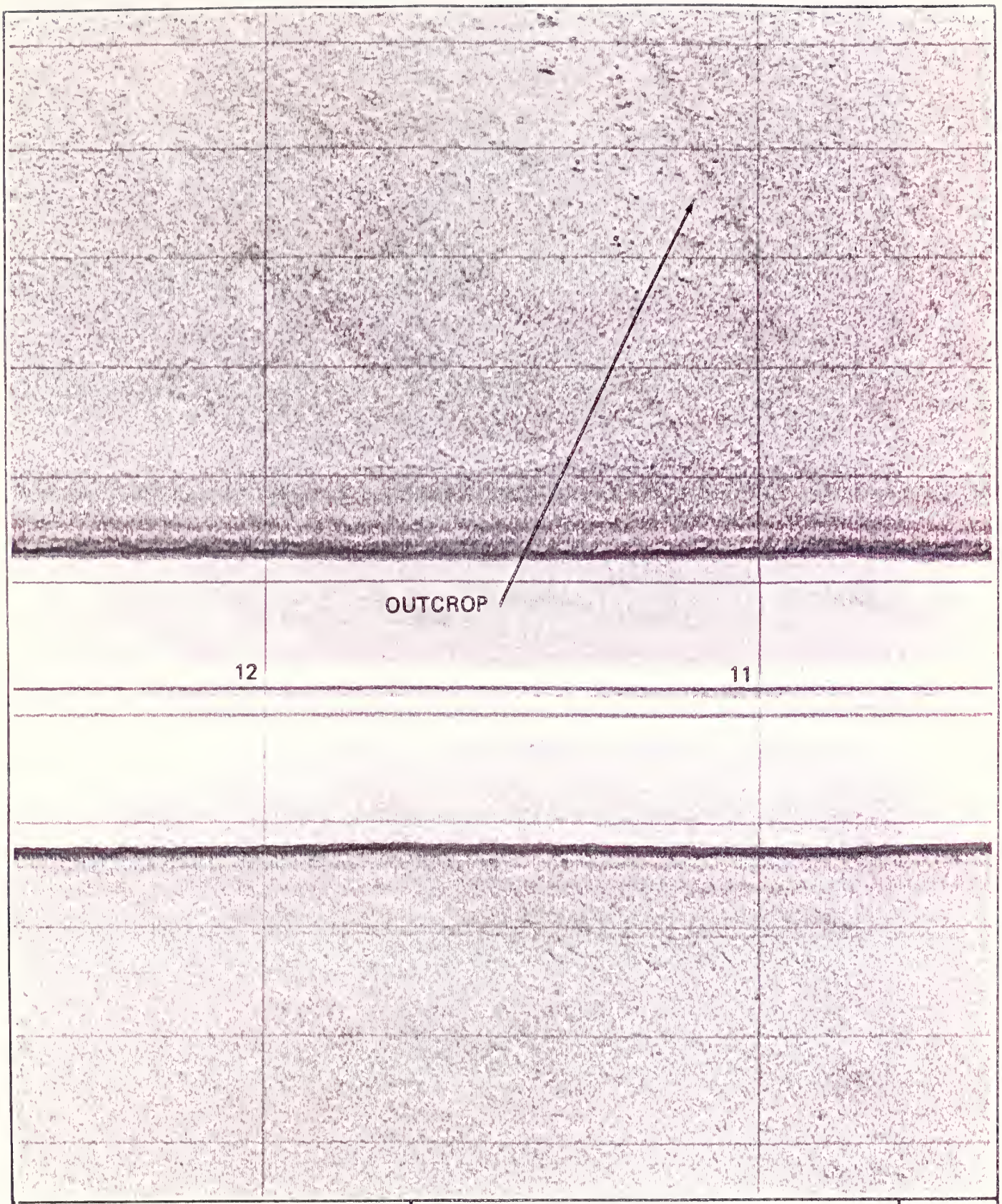
| Project: EASTERN GULF OF MEXICO<br>Project No. 41069 | UNIBOOM RECORD AREA 9, LINE 201 | Fig.<br>B-7 |

WOODWARD-CLYDE CONSULTANTS

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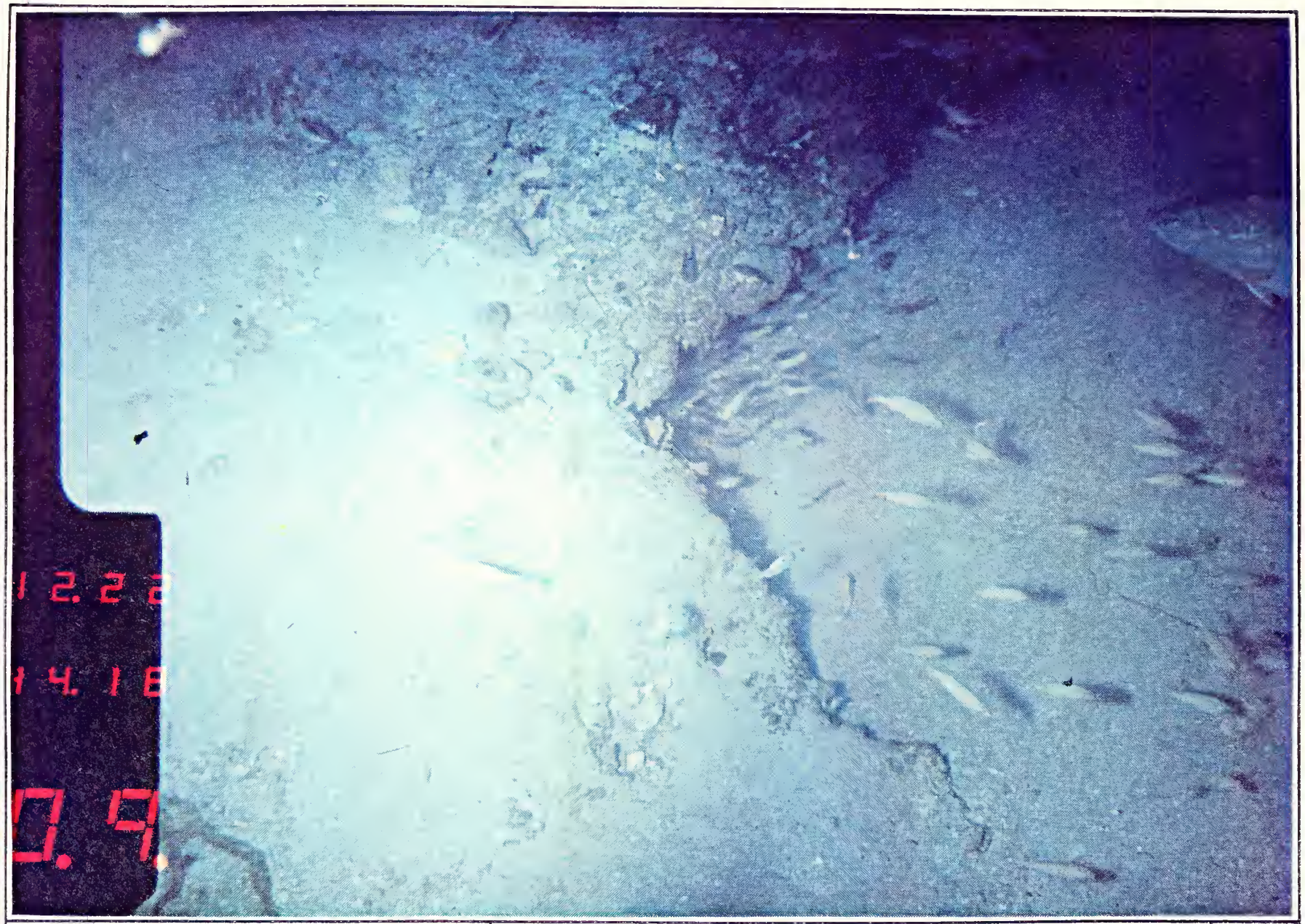
| Project: EASTERN GULF OF MEXICO<br>Project No. 41069 | SIDE SCAN SONAR RECORD<br>AREA 9, LINE 201 | Fig.<br>B-8 |

WOODWARD-CLYDE CONSULTANTS



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| Project: EASTERN GULF OF MEXICO<br>Project No. 41069 | BEDROCK LEDGE AREA 9, LINE 201, SP 9 | Fig. B-9 |

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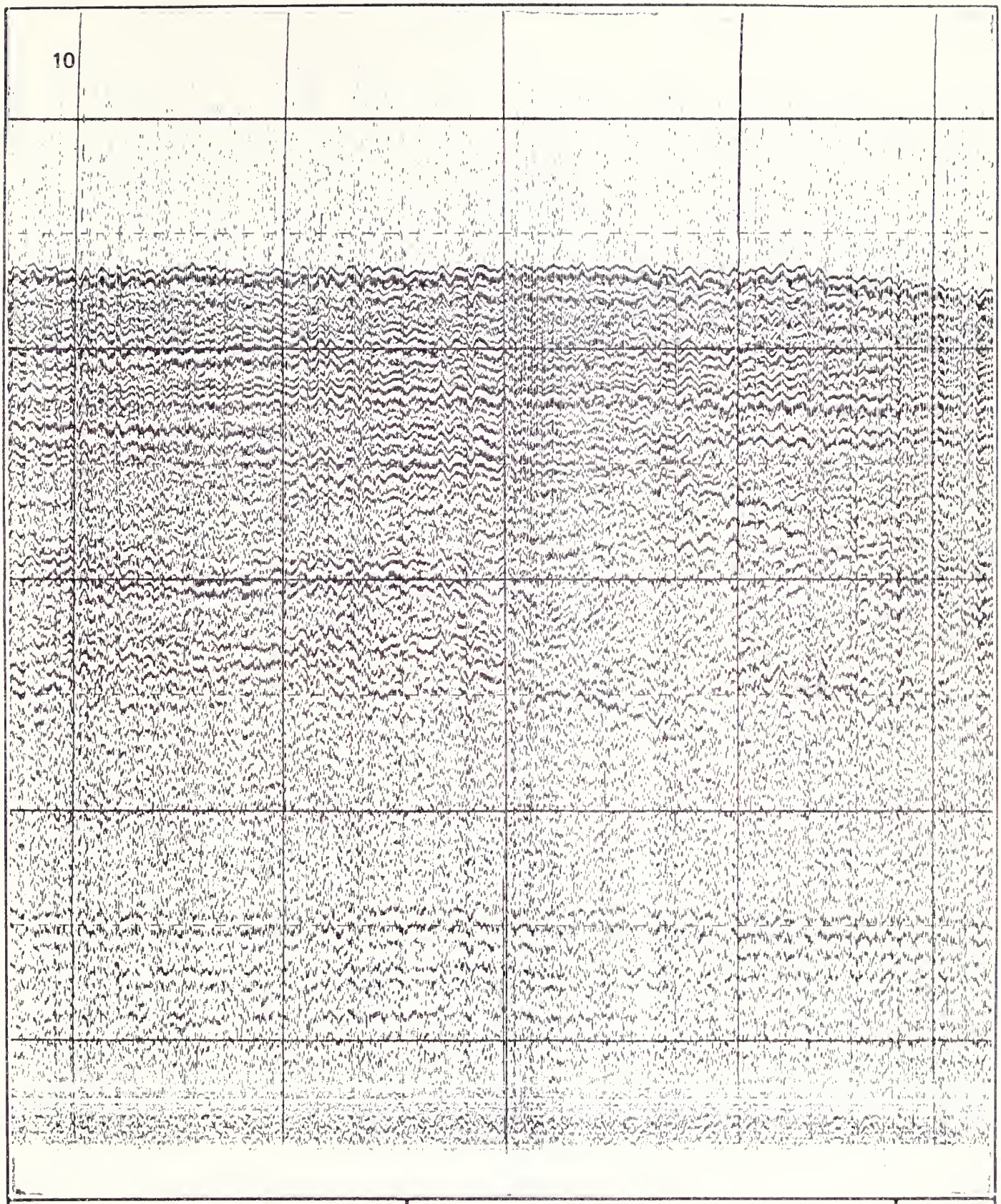
## B.6 COARSE BOTTOM

Figures B-10, B-11, B-12
Area 2, Line 102, Shot Points 10-12

Coarse bottom is actually a soft bottom category. It has been mapped where the side scan sonar or bottom photographs show a coarse textured sea floor sediment. The coarse texture may result from bedrock or reef rubble within a recent sediment cover or from biological activity that has created irregularities within a coarse sandy bottom area.

The general characteristics of a coarse bottom include an identifiable layer of unconsolidated sediment on the sub-bottom profiler record and a coarse texture on the side scan sonar record. The photograph, Figure B-12, clearly shows the coarse nature of the bottom sediment which appears to contain biological rubble.

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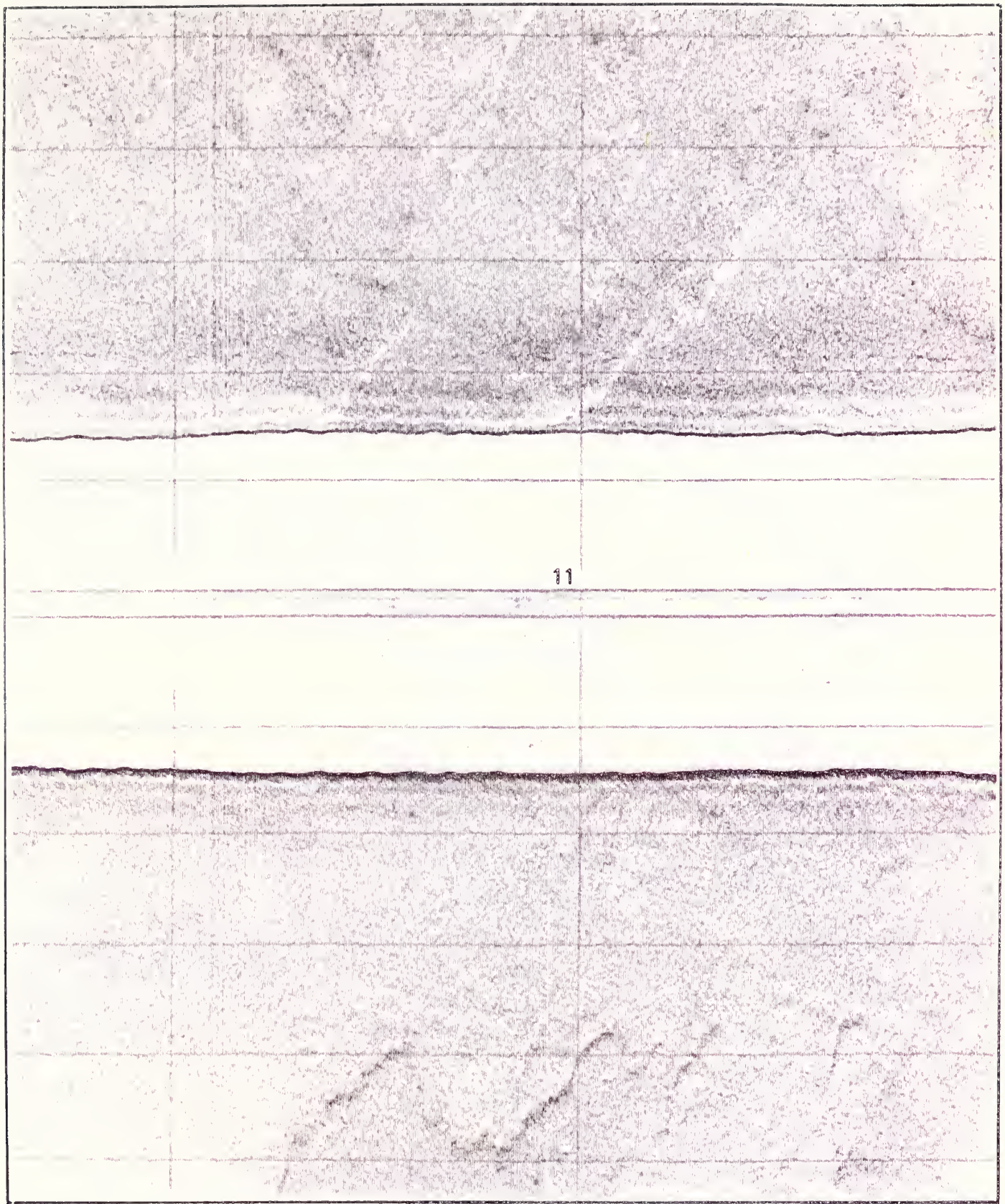
| Project: EASTERN GULF OF MEXICO<br>Project No. 41069 | UNIBOOM RECORD AREA 2, LINE 102 | Fig.<br>B-10 |

WOODWARD-CLYDE CONSULTANTS

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| Project: EASTERN GULF OF MEXICO<br>Project No. 41069 | SIDE SCAN SONAR RECORD<br>AREA 2, LINE 102 | Fig.<br>B-11 |

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| Project: EASTERN GULF OF MEXICO<br>Project No. 41069 | COARSE BOTTOM AREA 2, LINE 102, SP 10 | Fig.<br>B-12 |

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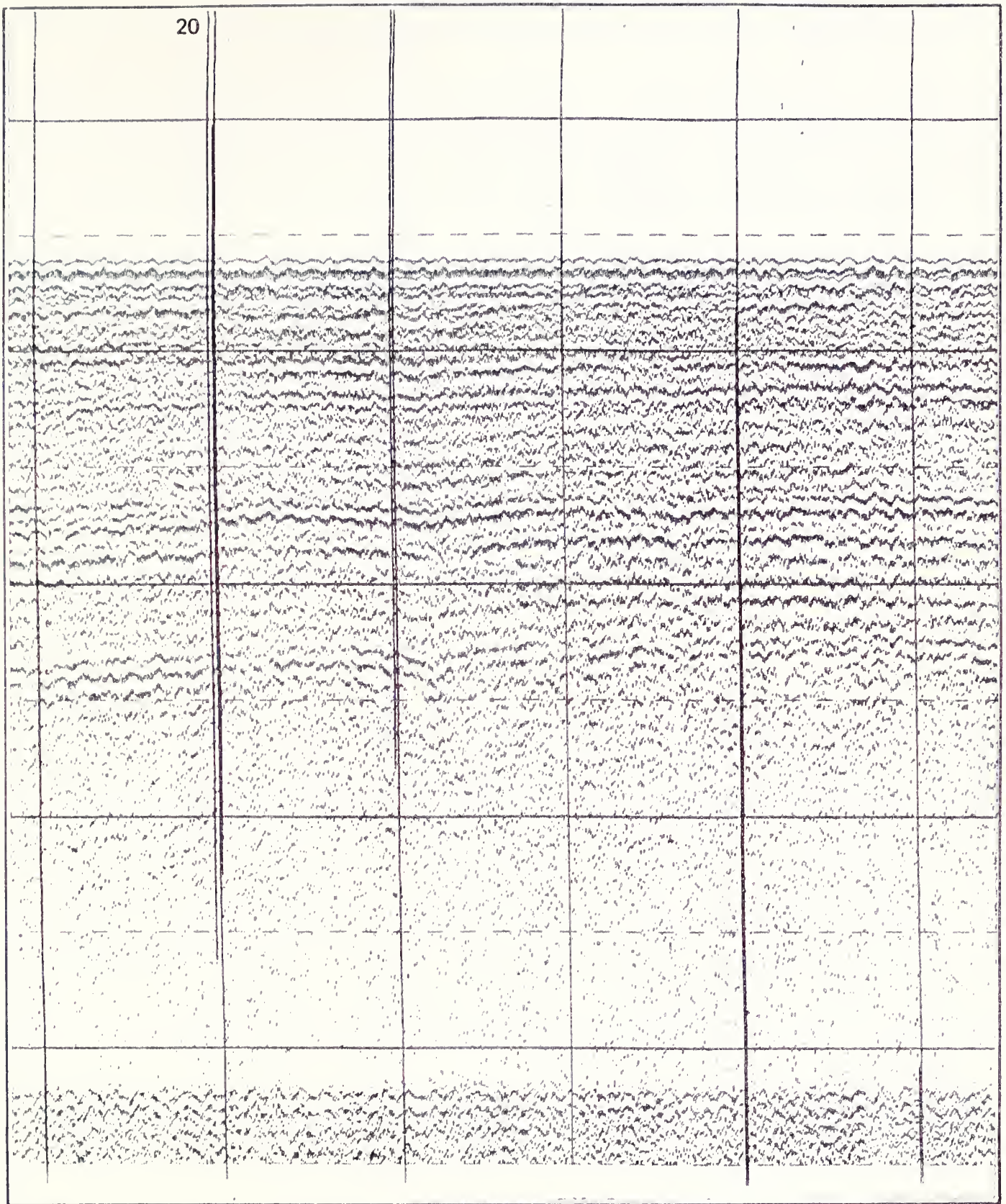
## B.7 BEDFORMS

Figures B-13, B-14, B-15
Area 8, Line 102; Area 9, Line 201

Bedform map areas have a sandy bottom that shows current or ripple marks or other low relief swells or dune-type features. These areas are essentially soft bottom areas and contain very few outcrops within the mapped bedform area.

Bedform areas were not selected for ground truthing and only a limited number of photographs contain any evidence of the bedforms. Bedforms may not appear obvious on a side scan sonar record unless the orientation between the tow fish direction and the bedform lineation is parallel. As a result it was necessary to select a side scan sonar record and bottom photograph from different transects in order to have a reproducible example.

The UNIBOOM record shows a flat sandy bottom with a relatively thin layer of unconsolidated sediments. The side scan sonar record from the same area shows well developed ripple marks of short wave length and low amplitude. The photograph from Area 9 shows similar features.

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| Project: EASTERN GULF OF MEXICO<br>Project No. 41069 | UNIBOOM RECORD AREA 8, LINE 102 | Fig.<br>B-13 |

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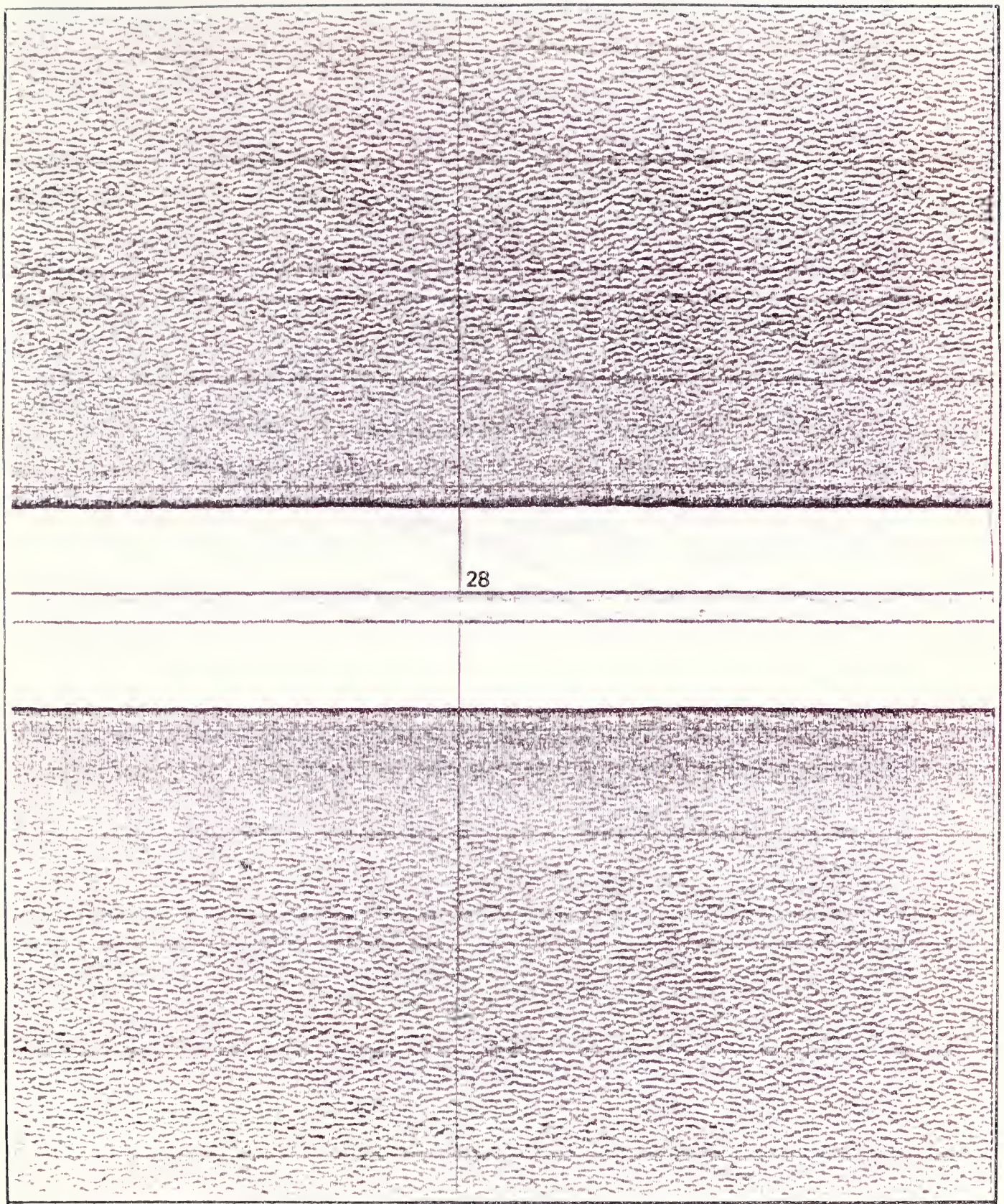


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| Project: EASTERN GULF OF MEXICO<br>Project No. 41069 | SIDE SCAN SONAR RECORD<br>AREA 8, LINE 102 | Fig.<br>B-14 |

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| Project: EASTERN GULF OF MEXICO<br>Project No. 41069 | SAND RIPPLES AREA 9, LINE 201, SP 6 | Fig. B-15 |

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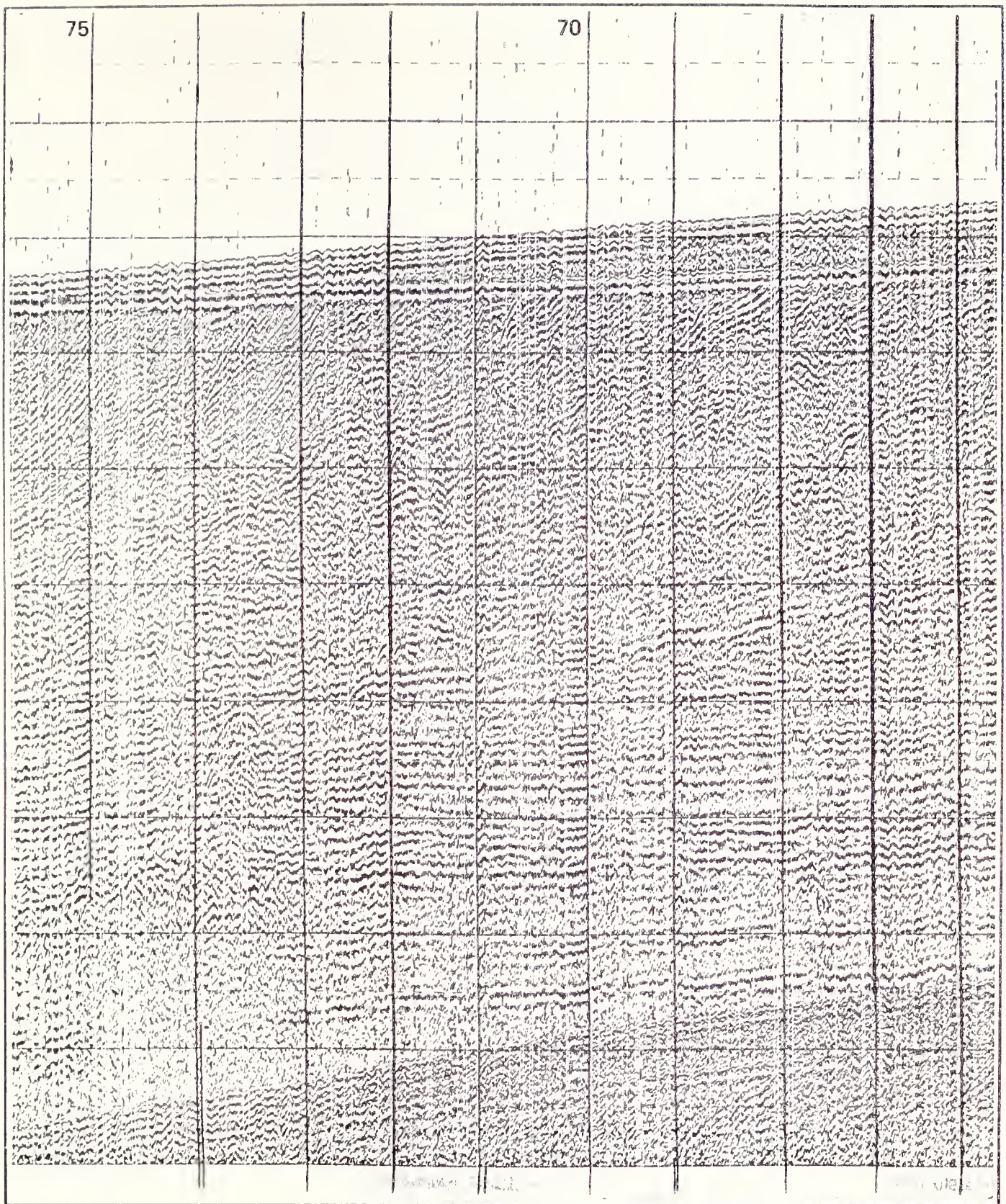
## B.8 SOFT BOTTOM

Figures B-16, B-17, B-18
Area 3, Line 105, Shot Point 70

Soft bottom has been mapped in areas of sand, silt, or mud bottom which appear devoid of a significant number of side scan sonar targets. Coarse bottom and bedforms are also soft bottom environments.

The UNIBOOM record, Figure B-16, illustrates a wedge of unconsolidated sediments at the sea floor. The thickness of the soft bottom sediments varies from a few centimetres, as reported in diver transects in Area 5, to over 8 m as shown on Figure B-16. The side scan sonar records may be featureless or have a coarse texture (Figure B-17) but generally will lack any target of mappable dimensions. Figure B-18 is typical of the soft bottom areas observed throughout the study area and clearly shows the mounds and depressions commonly referenced in the videotape transects.

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| Project: EASTERN GULF OF MEXICO<br>Project No. 41069 | UNIBOOM RECORD AREA 3, LINE 105 | Fig.<br>B-16 |

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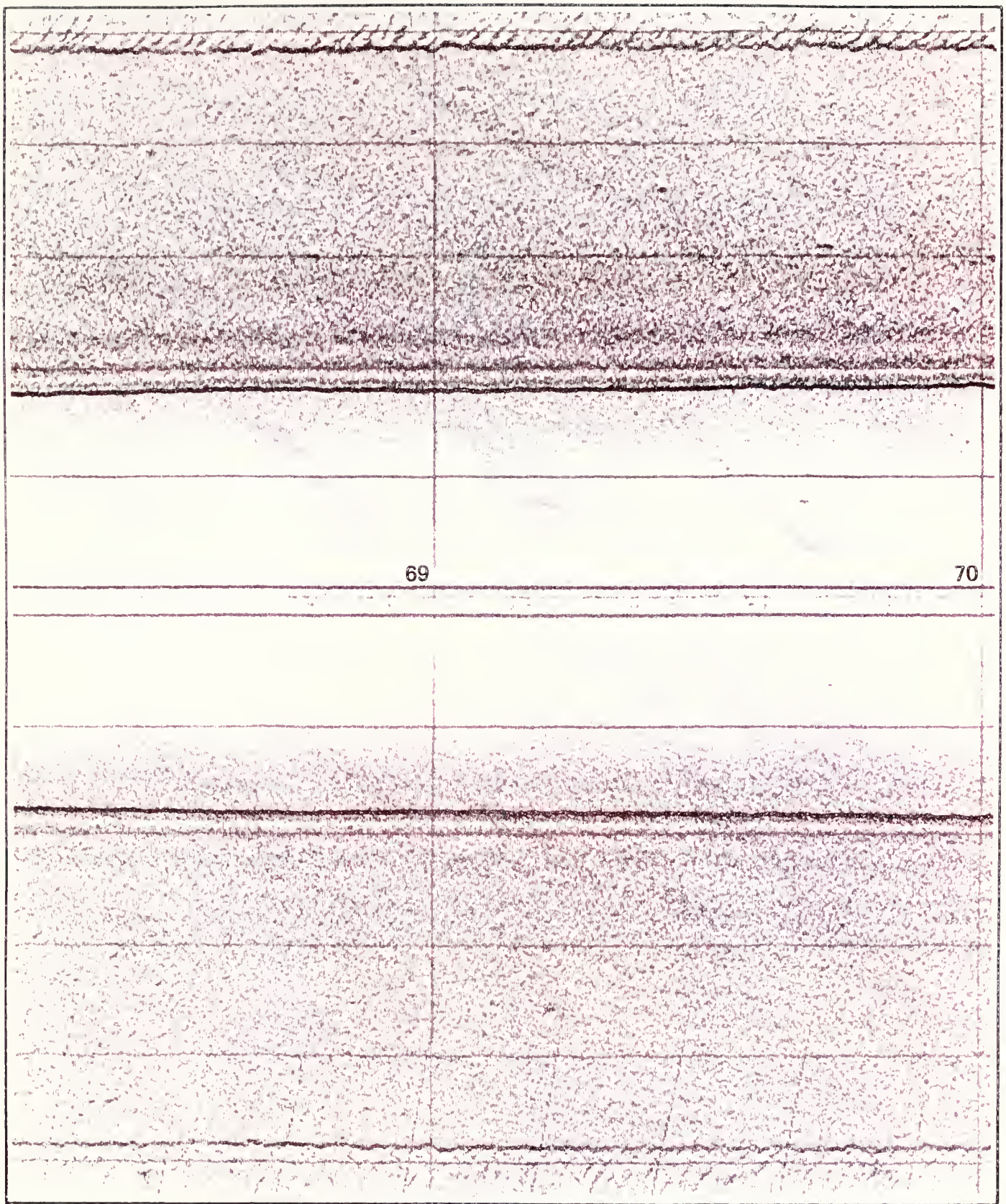


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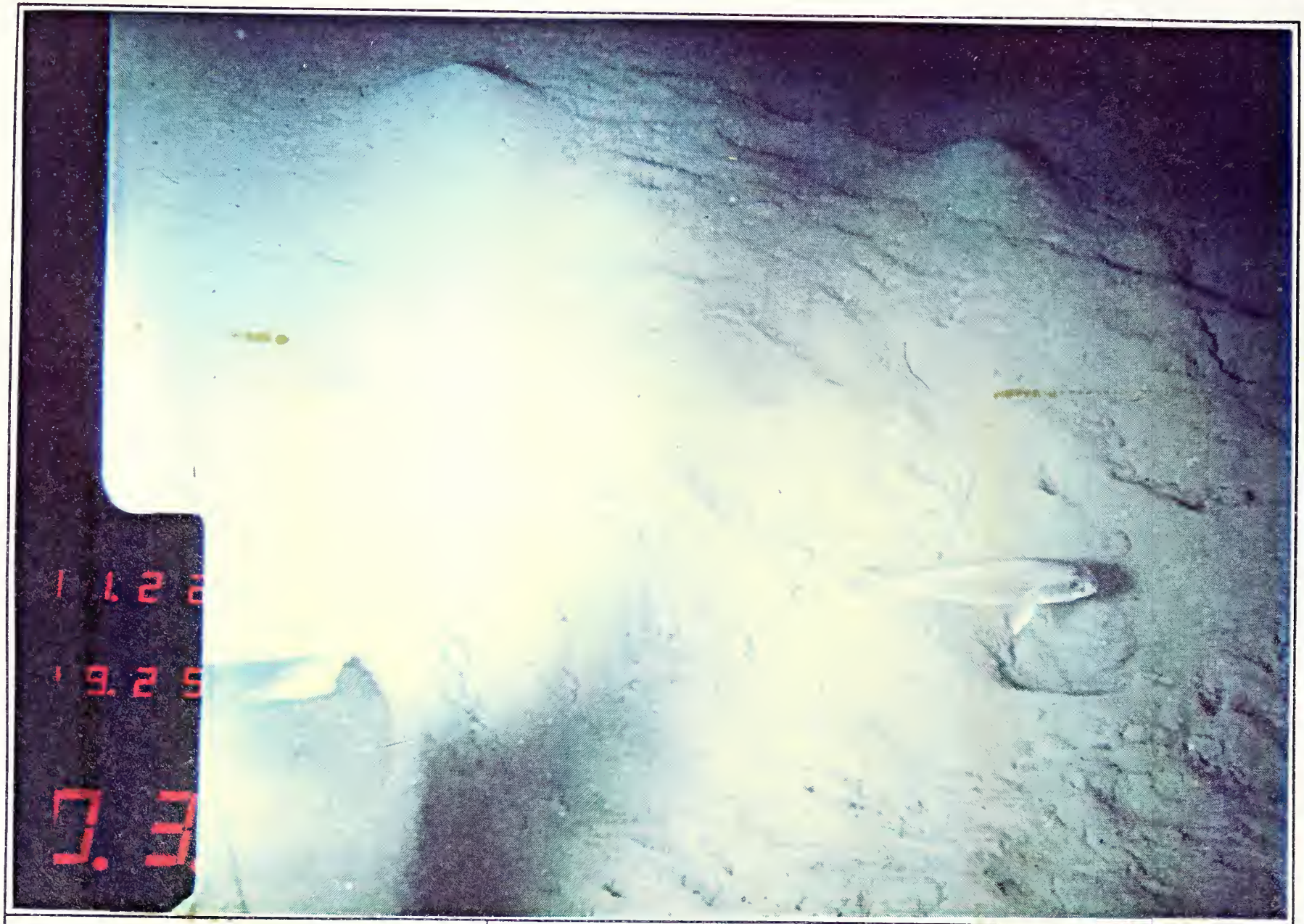
| Project: EASTERN GULF OF MEXICO<br>Project No. 41069 | SIDE SCAN SONAR RECORD<br>AREA 3, LINE 105 | Fig.<br>B-17 |



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| Project: EASTERN GULF OF MEXICO<br>Project No. 41069 | SOFT BOTTOM AREA 3, LINE 105, SP 70 | Fig.<br>B-18 |

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